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LIFE CYCLE COST/COST-EFFECTIVENESS ANALYSIS OF U.S. ARMY RECRUITS: HIGH QUALITY VERSUS LOW QUALITY

by

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This study is conducted to identify the relationship between a U.S. Army recruit's quality level and his or her life cycle cost (LCC). We develop a LCC spreadsheet model which considers critical costs accrued by an accessed population over a four year life cycle. Actual attrition data for a sample of the year groups under study is built into the model. LCCs of different percentage mixes of high and low quality are compared to find the least cost force mix. Additionally, we conduct a cost-effectiveness analysis by considering hands-on performance test results to determine the effects of performance on the cost to support a high and low quality soldier per man-year, respectively. Finally, we determine the marginal LCC (MLCC) of both high and low quality soldiers and compare these results. We discover through the use of performance factors that high quality recruits are more cost-effective in terms of their MLCC over the course of a first term enlistment.

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LIST OF ACRONYMS

AFQT - Armed Forces Qualification Test
AIT - Advanced Individual Training
AMCOS - Army Manpower Cost System Active Component Cost Estimation Model
ASVAB - Armed Services Vocational Aptitude Battery
AVF - All-Volunteer Force
AWOL - Absent Without Leave
BCT - Basic Combat Training
CAT - Mental Category
CG - Commanding General
DEP - Delayed Entry Program
DMDC - Defense Manpower Data Center
DoD - Department of Defense
DODOC - DoD Occupational Code
EST - Expected Survival Time
FY - Fiscal Year
GED - General Educational Development Certification
HOPT - Hands-On Performance Test
HSDG - High School Degree Graduate
IET - Initial Entry Training
IRR - Individual Ready Reserve
JPM - Joint-Service Job Performance Measurement/Enlistment Standards Project
LCC - Life Cycle Cost
MLCC - Marginal Life Cycle Cost
MOS - Military Occupational Specialty
NCO - Non-Commissioned Officer
NHSDG - Non-High School Degree Graduate
OCCAT - DoD Occupational Code Category
OMB - Office of Management and Budget
PLDC - Primary Leadership Development Course
R&D - Research and Development
RC - Reserve Component
SQT - Skills Qualification Test
SRA - Systems Research and Application Corporation
TOA - Total Obligational Authority
TPU - Training Program Unit
TRADOC - U.S. Army Training and Doctrine Command
TSC - Test Score Category
USACEAC - U.S. Army Cost and Economic Analysis Center
USAREC - U.S. Army Recruiting Command

I. INTRODUCTION

A. BACKGROUND

As the U.S. Army continues to downsize in the wake of the largest force reduction since the end of World War II, military leaders are struggling to ensure that the smaller force of the next decade is trained and ready to carry out its primary mission of decisive victory into the 21st Century. As stated in the United States Army Posture Statement for fiscal year 1995,

> America's Army today faces many challenges. It must become smaller; it must remain the world's preeminent land combat force in an uncertain world; and it must deal with declining resources and increasing missions [Ref. 1, p. 37].

Recent figures show that Department of Defense (DoD) budgetary outlays as a percentage of Gross National Product have declined from 6.3% in 1987 to 4.3% today [Ref. 1, p. 38]. Clearly, the Army must share the burden of dealing with these resource cuts. Dwindling resources not only dictate a force structure that must be smaller in size but budget reductions may also have an impact on the quality level of future Army manpower. Financial resources help define the readiness and capabilities of the force. The Army's future combat effectiveness will be determined by the quality of its soldiers.

The challenge Army leaders must now address when molding the future force structure is determining the necessary recruit quantity and quality requirements to meet all future missions. Military leaders from all the Services are now being asked to fully justify large expenditures on manpower at a time when military forces are being reduced in size.

No one knows exactly what quantity of high quality soldiers is necessary to ensure success on the battlefield. However, most would agree that a military force composed primarily of high quality soldiers will act as a force multiplier in any future war scenario.

Current figures show that it costs an average of $7,000 to access a soldier into the Army. This expenditure only covers recruiting costs. Compared to the other military services, the Army's cost is high. Some members of Congress are now asking why Army

recruits are so expensive. There have even been suggestions that the quality levels of Army recruits be reduced in order to lower the cost per accession. These same lawmakers feel that American taxpayers are paying too much to fill the ranks of the Army with an unnecessarily large percentage of high quality soldiers. However, to capture the actual cost of a soldier, we should consider not only the accession cost but all other costs accrued over the course of that soldier's life cycle. Only then can we determine the true cost-effectiveness of a high quality or a low quality soldier.

B. OBJECTIVES

The purpose of this study is to analyze whether recruiting more low quality soldiers into the Army is a viable method of lowering recruiting costs. The issue will be looked at from a life cycle cost (LCC) perspective in order to take into consideration as many relevant cost factors as possible before coming to any conclusions. The LCC model used in this study includes recruiting costs, training costs and the costs to sustain a soldier throughout his or her first term of enlistment.

LCC comparisons must be made between a high quality recruit and a low quality recruit before policy changes are implemented. Once we develop a LCC model, cost-effectiveness analyses are conducted.

C. RESEARCH QUESTIONS

This study examines the LCC of high quality and low quality recruits entering the Army on an annual basis. Efforts are directed toward answering the following questions.

1) What relationship, if any, exists between the quality level of a recruit and his or her LCC?
2) What potential LCC savings are there, if any, if the quality mix is adjusted to allow for more low quality soldiers?
3) Is there a relationship between a recruit's quality level and his or her hands-on performance capability? If so, what influence does a soldier's performance capability have on his or her LCC?
4) What is the marginal LCC (MLCC) of a high quality and a low quality soldier?

D. SCOPE

The scope of this thesis is to conduct an LCC analysis using U.S. Army recruiting, training and compensation cost factors and incorporating them into a LCC spreadsheet model. The cost factors are representative of high quality and low quality recruits, respectively. The analysis is based on historical data gathered relating to soldiers accessed during fiscal years 1986 through 1990. Corresponding attrition data for a sample of each year group represents attrition rates during the first term of their enlistment. The accession and attrition data are provided by the U.S. Army Recruiting Command (USAREC), Fort Knox, Kentucky and the Defense Manpower Data Center (DMDC), Monterey, California. In this study we consider our soldier life cycle to be four years in length. This span of time is used because an average first term enlistment is considered to be four years in length.

We utilize the Army Manpower Cost System Active Component Cost Estimation Model (AMCOS) to derive our costs. The cost parameters and formulas developed in the model are part of a larger DoD manpower research project known as the Joint-Service Job Performance Measurement/Enlistment Standards (JPM) Project. Much of our research is a continuation of the JPM Project.

We develop and use LCC spreadsheet models to conduct what-if analyses as we vary the percentage of high quality soldiers entering the force. The spreadsheet models also allow us the opportunity to change other input values and determine what effects these changes will have on our LCC. These input values include performance factors and the desired end-strength at the end of four years.

We perform a cost-effectiveness analysis to determine what effect different levels of hands-on test performance have on a soldier's LCC. We use performance factors in the study to convert man-years of work contributed by the population into performance-adjusted man-years. With these figures we are able to determine the LCC per man-year of both a high quality and low quality soldier.

Finally we determine the MLCC of a high quality and a low quality soldier, respectively. The MLCC indicates the difference in LCC due to an increase in the performance-adjusted end-strength of one additional high and low quality soldier.

E. ORGANIZATION OF STUDY

In Chapter II we provide an overview of the studies and events leading up to the current time. We review numerous theories that have been presented by both military and civilian experts in the field of recruit quality and its effects on first term attrition rates.

In Chapter III we discuss the soldier LCC concept. This chapter involves an analysis of how recruiting, training and sustainment costs are derived in accordance with the AMCOS model and other models introduced over the past several years. Our methodology is described to show how we calculate a hypothetical soldier's LCC using historical attrition data and a spreadsheet model.

In Chapter IV we examine how hands-on performance factors play a critical role in determining the true cost-effectiveness of a soldier. We also determine the MLCC of high and low quality soldiers, proving that high quality soldiers are more cost-effective than low quality soldiers over the course of a soldier's life cycle.

Chapter V summarizes the findings of our study, provides conclusions that are drawn from these findings, and provides recommendations.

II. BACKGROUND

A. HIGH QUALITY SOLDIERS IN THE ARMY: AN HISTORICAL PERSPECTIVE

Concerns about the quality of our fighting forces were first voiced after the 1970 Gates Commission recommended the formation of an All-Voluntary Force (AVF) to support United States national and international interests. Because of sufferings still being felt as the Vietnam War wound down, many believed that an AVF would not be able to attract significant numbers of quality volunteers to fill the ranks of the Army. The Gates Commission concluded that mental category (CAT) IV soldiers (defined later) and non-high school graduates could perform as well as higher quality personnel in many Military Occupational Specialties (MOS). The Commission also concluded that the Services could afford to lower enlistment quality standards if there should ever be a scarcity of manpower appropriations.

In 1977, the RAND Corporation was asked to study the AVF and determine its capability to provide enough quality people annually in order to avoid declines in manpower quality. The report concluded that the AVF "can attract a socially representative mix of the desired quantity and quality of new recruits...at a cost substantially lower than commonly assumed." [Ref. 2, p. 2] The study also concluded that CAT IV high school graduates are more productive in low and medium skilled jobs than high mental category non-graduates. It therefore recommended the Services consider recruiting more CAT IV high school graduates in an effort to save money [Ref. 2, p. 5].

From 1976 through 1980, a devastating event occurred which was to affect all of the military Services for many years to follow. In this time frame, otherwise known as the "Dark Ages of military manpower and recruiting" [Ref. 3, p. i], nearly 50 percent of the personnel allowed to enter the Army had scored in the bottom half of the Armed Forces Qualification Test (AFQT). Simply stated, 50 percent of incoming Army personnel were considered to be substandard recruits who would have otherwise not been eligible for enlistment. It was later found that the cause of this mistake was due to the Armed

Services Vocational Aptitude Battery (ASVAB) tests being misnormed, causing test scores to be inflated. Without knowing it, the military had dramatically lowered its overall level of quality. Some of the negative results of having too many low quality recruits were increased disciplinary problems, increased drug and alcohol use and a higher incidence of Absent Without Leave (AWOL) cases. Only recently have soldiers in these cohorts retired from military services, if they made it at all.

If this event did nothing else, it made military and public leaders alike realize that the quality of our military forces is critical to our survival. The event also led to numerous studies which began to look at what type of effects a lower quality mix of soldiers would have on military readiness. Several of those studies are referred to and discussed in detail throughout the remainder of this study.

Currently, the Army and its sister services are faced with having to operate with fewer and fewer fiscal dollars. As the Army downsizes, all decisions affecting manpower procurement and management, military training, research and development (R & D), and overall capital investment in the organization and maintenance of the Army must be considered. In examining each portion of the essential budget elements of the Army system mentioned above, a conscious and rational decision must be made by the highest echelons of Army leadership as to how the annual budget will be divided. Not only is this a difficult and exhausting process, but decisions made now will shape the structure and overall force capabilities of the Army for the future. Large cuts in the recruiting budget could lead to fewer high quality soldiers entering the system. Yet at the same time, large cuts in training, R & D or maintenance of force equipment and facilities could also lead to a depletion in readiness.

Cuts in any of the areas mentioned will have a long lasting effect on the Army's readiness. Yet as we focus in on the area of recruiting new soldiers into the Army, we begin to see long-term effects, both negative and positive, in recruiting more high quality people at a higher cost or recruiting more low quality people at a lower price. With a

smaller cohort to be accessed each year during the drawdown and possibly beyond, the importance of recruiting enough high quality soldiers becomes more critical.

Analysis of the soldier's LCC is necessary to determine the impact of recruiting budget cuts over a period of time. This analysis also assists us in determining whether we have made an efficient investment of our scarce resources.

B. MEASURING RECRUIT QUALITY

The issue of recruit quality and its cost-effectiveness has been at the center of debate since the end of World War II. Because of the many technological advancements that were introduced during this global conflict, the newly established DoD realized the need to develop a method by which it could predict the quality and thus the effectiveness of a new recruit. By using such a method, the individual Services can ensure a good match of the mental capabilities of a recruit and the technical complexity of the MOS the soldier is assigned to. The Services use assessment of quality needed to meet technical school input requirements and projected mid-level manager and Non-Commissioned Officer (NCO) positions. Thus they estimate the accession quality needed to sustain the force over the long run. The long run implications of recruiting too many lower quality soldiers begin to show up several years into a military career when the privates of today become the NCOs in the Army ranks tomorrow. Some MOS managers have reported in the past that NCO performance levels were not satisfactory, which can be strongly attributed to the fact that lower quality people were allowed to enter those MOSs many years prior. In order to correct this problem, standards calling for higher AFQT scores and a larger percentage of recruits possessing a high school diploma have been used to support future leadership effectiveness requirements [Ref. 4, p. vii].

The military uses characteristics of potential hires such as aptitudes, interests and education to predict success in the jobs the applicants are seeking. Since the Services mostly hire individuals with little or no job experience, the aptitude and education characteristics become the basic screening criteria for determining eligibility for entry into the service and into a specific MOS [Ref. 4, p. iii]. Because there is no demonstrated

performance history on most enlistees, the Services rely heavily on educational attainment (high school graduate status) and scores on the AFQT. The AFQT is a portion of the ASVAB that is described in the next section.

The Services have concluded that an entrant with a high school diploma and an average to above-average score on the AFQT is more adaptable and easier to train, at least through the first term of enlistment. In the next four subsections, we will discuss the process of how the measure of a quality recruit has been developed and how its results are used when matching individual capabilities to job complexities.

1. Armed Services Vocational Aptitude Battery

In 1958, the ASVAB was developed and was administered to students at selected high schools across the United States [Ref. 5, p. 30]. During several years of testing, the ASVAB was validated and its results were compiled into a computer database. Given the nature of the results obtained from the ASVAB, DoD determined that such a bank of information describing the mental attributes of America's youth would be an invaluable manpower tool that could be used to fill the ranks of the Armed Forces quickly in the event of a national crisis. The information stored in the database would allow military manpower planners to quickly match an individual citizen's capabilities to required job complexities. Because of the strategic implications of such a system, the ASVAB was introduced into the national high school system in 1968 [Ref. 5, p. 31]. Currently, the ASVAB consists of 10 subtests. These are identified in Table 1.

Subtest Code	Content Area
GS	General Science
AR	Arithmetic Reasoning
WK	Word Knowledge
PC	Paragraph Comprehension
NO	Numerical Operations
CS	Coding Speed
AS	Auto & Shop Information
MK	Mathematics Knowledge
MC	Mechanical Comprehension
EI	Electronics Information

Table 1. ASVAB Subtest Categories [Ref. 6].

Under normal circumstances, most high school seniors nationwide take the ASVAB. Once they take the test, their results are stored in a nationwide database. Hence, if a high school senior or high school graduate becomes interested in joining the military, his or her test results are already available to the local recruiter processing the potential recruit. If the applicant either has not taken the ASVAB or received a low score on a prior test, he or she can request to retake the exam.

2. Armed Forces Qualification Test

Once the ASVAB results of an applicant are on file, the issue of quality is first considered. In order to quantify an applicant's level of quality, the AFQT is used. The AFQT was developed by the military Services in order to ensure military applicants are mentally acceptable to perform required military skills of varying levels of complexity.

The AFQT consists of four of the 10 ASVAB subtests which have been determined to directly relate to aptitude requirements needed to perform adequately in a military environment. The four subtests composing the AFQT are, (1) paragraph comprehension (PC), (2) word knowledge (WK), (3) mathematics knowledge (MK), and

(4) arithmetic reasoning (AR). These four subtests constitute the quantitative and verbal factors of the ASVAB. [Ref. 6, p. 71]

The score an applicant receives on the ASVAB is converted into an AFQT percentile ranking which is derived by comparing an individual's AFQT raw score to the test population's mean score. The actual AFQT raw score which is subsequently defined as a percentile score is derived as follows:

(2.1) $$AFQT = PC + WK + MK + AR.$$

Applicants are then placed into one of six basic mental categories, also referred to as Test Score Categories (TSC). The TSC codes are shown in Table 2.

Quality Category	Percentile Ranking	Level of Trainability
I	**93 - 100**	**Well Above Average**
II	**65 - 92**	**Above Average**
IIIA	**50 - 64**	**Average**
IIIB	**31 - 49**	**Average**
IV	**10 - 30**	**Below Average**
V	**0 - 9**	**Well Below Average**

Table 2. TSC Codes Based on AFQT Scores

Numerous research projects have determined that there is a substantial link between measured aptitude (job performance potential) and demonstrated performance (actual hands-on job performance) [Ref. 7, p. 2-6]. Another study concluded that AFQT CATs I-IIIA produced at least 10 percent more "output" than lower quality personnel across all MOSs [Ref. 4, p. 53]. At this time the AFQT is the only aptitude test being used by the Services during the recruiting process.

The percentile ranking a potential recruit receives from the AFQT becomes one indicator of his or her level of quality according to military standards. The TSC is considered a strong indicator of future military performance. Those scoring in the top 50

percent (CAT I-IIIA) are considered easier to train and should therefore be more productive in terms of work output during their first term of service. It was found that "lower-aptitude personnel are harder to train than their higher scoring peers, even in low and moderate skill jobs. An important reason is low reading abilities -- frequently at the 5th to 7th grade levels among persons in AFQT category IV." Even with changes in manuals and more hands-on testing, "low-aptitude personnel require longer training periods. In some jobs, they also have higher failure rates." [Ref. 4, p. iv] By law, applicants falling into the CAT V are ineligible for military enlistment. It is precisely for these reasons that the Services put much faith in AFQT results.

Figure 1 illustrates the mixture of TSCs (or CATs) for FY 1990. Out of 89,619 soldiers accessed in this cohort only 1,703 (or 1.9%) were in the CAT IV population. The percentage of high aptitude recruits (CAT I-IIIA) accounted for 67.1% of the cohort.

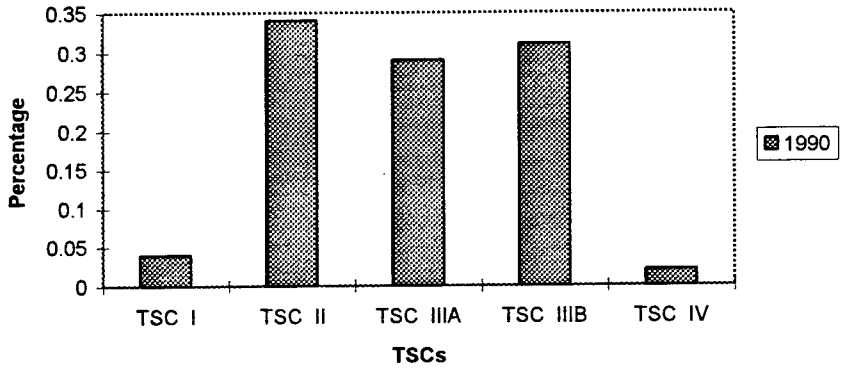


Figure 1. FY 1990 TSC Mixture

Although the number of CAT IV soldiers fluctuates from year to year, their representation of the total accession population has declined significantly from 4.6% in 1986. In contrast, the percentage of high aptitude recruits (CAT I-IIIA) has steadily increased. For FY 1994 CAT I-IIIAs represented nearly 71% of the total population

[Ref. 8]. Clearly the trend is toward recruiting more high aptitude recruits as gleaned from USAREC's current recruitment goal of at least 67% CAT I-IIIA.

3. High School Degree Graduate Status

Historical data shows that soldiers with a high school diploma have a lower attrition rate than those not possessing a diploma. The explanation for this trend is that those individuals who have the determination and maturity to finish 12 years of schooling tend to carry these qualities over into their military enlistment throughout their first term. At USAREC this is referred to as "stick-to-itiveness." Other findings further conclude that high school degree graduates (HSDGs) are less likely to engage in drug use, are less likely to go AWOL, and have lower rates of disciplinary problems. [Ref. 4, p. 6]

Accession groups with a higher proportion of non-high school degree graduates (NHSDG) must be larger in size in order to compensate for an increased number of first term attritions. The larger accession cohort incurs additional costs. Recruiting costs will increase as USAREC works to keep the training base supplied with fresh recruits. Not only will the search for more recruits further tax the time of the recruiters in the field, but the expanded recruiting mission requirement could possibly lead to the need for more recruiters to find potential recruits. Training base costs will also increase as more trainees raise the total cost of training.

For purposes of categorizing those recruits who are either high quality or low quality candidates, a distinction has been made between having a high school degree diploma or not. Recruits with alternative high school degree diplomas such as a General Educational Development (GED) certificate are considered to be non-graduates.

Because a HSDG has a greater probability of finishing the first term of their military commitment, USAREC, and all the Services for that matter, strive to obtain the highest proportion of HSDGs possible. Figure 2 shows how a sample consisting of four MOSs accessed in FY 1990 has fared in terms of educational status (HSDG/NHSDG) over the last several years. This sample consisted of 94% HSDG and 6% NHSDG upon accession.

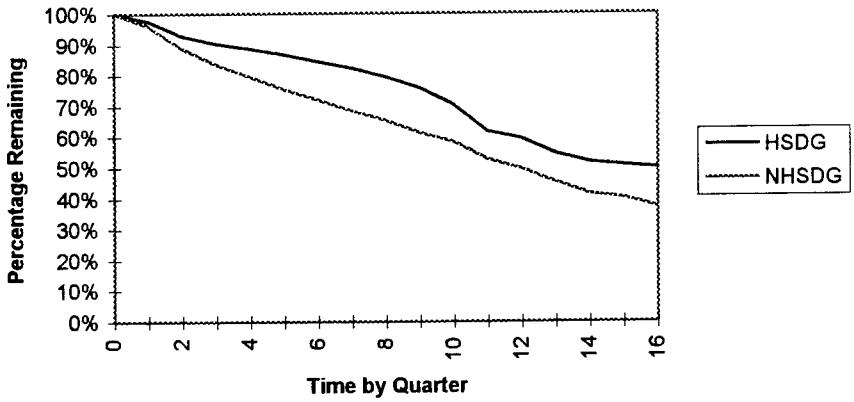


Figure 2. FY 1990 HSDG/NHSDG First Term Survival Rates

The chart shows that of 11,953 HSDGs who were accessed into the sample in FY 1990, 50% (or 5,947) remained after the average first term length of four years or 16 quarters. On the other hand, of the original 641 NHSDGs in the sample, only 37% (or 239) remained after the first term. This clearly supports the fact that a higher percentage of HSDGs remain in service throughout their first term than do NHSDGs. It is precisely because of this fact that USAREC sets its recruiting levels for HSDGs so high; currently at 95%. The return on investment in terms of recruiting, training and sustainment costs is much greater for HSDGs than NHSDGs because they have a higher probability of completing their first term of service.

4. USAREC Quality Goals

Currently, USAREC is setting high standards for its recruiters nationwide. In order for the Army to keep pace with its desired quality levels, military leaders have set quality parameters relatively high in order to ensure a capable force structure in the long run.

The aim of our study is to evaluate a cohort's quality characteristics as they are defined by USAREC. In this way, our results coincide with policymakers' definitions of a high quality and a low quality soldier. Finding the definition of a high quality soldier is rather simple because its definition has been mandated by Congress. Therefore, we can

state with certainty that a high quality soldier is one who is a HSDG *and* CAT I-IIIA. Note that to qualify as a high quality soldier, the entrant must meet both of these conditions.

When searching for the definition of a low quality soldier, the issue becomes somewhat unclear. With certainty we can state that low quality soldiers are defined as those which are a HSDG *and* CAT IIIB-IV. But what about soldiers who are NHSDGs and CAT I-IIIA? Are they categorized as high quality or low quality soldiers? After discussions with the Chief of the Plans Branch, Program Analysis & Evaluation Directorate at HQ USAREC, we found that no definitive answer to this question exists. According to our source, "This could be a debatable point." No current policies exist which would identify, for example, that a CAT I soldier who is a NHSDG is considered anything other than a low quality soldier because he or she does not possess a high school degree. Therefore, for purposes of this study, we define a low quality soldier as one who is a HSDG *and* CAT IIIB-IV or a NHSDG *and* CAT I-IV. Again note that to qualify as a low quality soldier the entrant must meet one of these conditions. Simply illustrated, we have used the following parameters in our definitions of quality.

1) High Quality: HSDG *and* CAT I-IIIA
2) Low Quality: HSDG *and* CAT IIIB-IV or NHSDG *and* CAT I-IV.

Applicants scoring in the CAT V zone (0-9th percentile) have been determined to be ineligible to serve in the military by law.

Because of the selective nature of the process, only about 14% of the total 17-21 year old male population found in the United States are considered to be high quality recruit candidates. This makes the mission of the recruiter even more difficult. Table 3 provides the current quality parameters which have been set by USAREC.

Percentage	Category
≥ 95%	High School Diploma / Senior
≥ 67%	CAT I - IIIA
≤ 2%	CAT IV

Table 3. USAREC Mission Requirements [Ref. 9, p. 49].

Recent figures show that USAREC is keeping up with the tough standards it has set for itself. For FY 1994 the number of HSDGs recruited was 95.2%, the CAT I-IIIA percentage was 71%, and the CAT IV percentage was recorded at only 1.8% [Ref. 8].

C. CATEGORIZING MILITARY OCCUPATIONS

1. Army Aptitude Area Scores and MOS Assignment

In order for the Army to fill its enlisted ranks with the quantity and quality required to ensure mission effectiveness, manpower managers have set up a system that provides a visible and logical progression of personnel from entry into the training base to retirement in the grade of Sergeant Major (E-9). The process of selecting the right person for the right MOS plays a critical role in determining whether an MOS cohort for a given FY will remain in sufficient numbers at the end of the first term to enter the career force. Therefore, the mixture of high quality and low quality recruits placed in each MOS annually will influence the capabilities of those MOSs in the future.

Each MOS proponent provides the number of first term soldiers needed to replenish the losses from the career force on an annual basis. Open positions in the organizational structure of the Army are filled by these new entrants by what is referred to as a "bottom-fed" personnel system. This simply means that the Army trains and grows its own future leaders starting with new recruits and eventually ending up with an effective future leader of troops. In order to reach this end goal of raising competent soldiers and technicians who will become the future ranking leaders in the Army, MOS managers are asked to balance their need for high quality recruits with the actual skill requirements of MOSs falling within their area of responsibility.

It is a well-known fact among MOS managers and manpower researchers alike that,

> While the minimum aptitude area score predicts the ability of a recruit to complete initial training and perform MOS skills at entry level, if all accessions fall at the minimum score, the Army will not have an adequate pool of individuals needed to furnish the NCO career force and leadership required...to operate and maintain complex equipment, or to replace losses beyond first-term attrition. [Ref. 4, p. 12]

Thus the issue of force quality mixture is found to be present at various levels of manpower decision-making within the Army. It is precisely for this reason that each MOS training proponent plays such a key role in deciding how much quality is needed within the ranks of the Army.

The MOS training proponents are responsible for setting the minimum aptitude area score that must be attained by a recruit in order to qualify for a particular MOS. The officer and NCO subject matter experts managing each of the respective MOSs define these minimum scores based on their field experience. The minimum aptitude area score must then be approved by the Commanding General, U.S. Army Training and Doctrine Command (CG, TRADOC) and the Deputy Chief of Staff for Personnel [Ref. 10, p. 21].

Presently there are nine Army aptitude area categories that are used to determine which MOS a new recruit is qualified to serve in. Each category is a composite of several subtests found in the ASVAB discussed earlier in this chapter. The nine category scores are calculated for each recruit and these scores are used by USAREC to place the right person in the right MOS. The current aptitude area composites used by the Army for MOS selection are [Ref. 6, p. 148]:

1) EL -- Electrical
2) CL -- Clerical
3) MM -- Mechanical/Maintenance
4) CO -- Combat
5) FA -- Field Artillery

6) OF -- Operations/Food

7) SC -- Surveillance/Communications

8) ST -- Skilled Technical

9) GM -- General Maintenance.

For those familiar with the Army aptitude areas, the area that fell under the title of General Technical (GT) is no longer considered an aptitude area as of 1994. Table 4 provides a breakdown of the aptitude area categories and lists their respective ASVAB composite scoring formula.

Aptitude Area Category	ASVAB Composite Score
Electrical (EL)	GS + AR + MK + EI
Clerical (CL)	PC + WK + AR + MK
Mechanical/Maintenance (MM)	NO + AS + MC + EI
Combat (CO)	AR + CS + AS + MC
Field Artillery (FA)	AR + CS + MK + MC
Operations/Food (OF)	NO + AS + MC + WK + PC
Surveillance/Communications (SC)	AR + AS + MC + PC + WK
Skilled Technical (ST)	GS + MK + MC + PC + WK
General Maintenance (GM)	GS + MK + EI + AS

Table 4. Army Aptitude Area Categories [Ref. 6, p. 148].

Different MOSs will have different minimum aptitude area scores based on the complexity of the occupation. The JPM Project recently concluded that since the individual ASVAB subtest scores are positively correlated to the composite AFQT, it can be assumed that the higher the cut-off composite score for a particular MOS the higher the average quality of the recruit in that MOS [Ref. 6, p. 149]. It is for this reason "...the Services seek to enlist a distribution of recruit quality above the minimum to be certain that performance in all military specialties will be sufficient to accomplish the Service mission." [Ref. 7, p. 3-3]

A major concern in setting the minimum aptitude area scores is that the MOS training proponents may inflate their actual minimum requirements in order to avoid receiving a larger proportion of the lower quality recruits being admitted into the Army. By increasing the minimum aptitude area score, an MOS proponent may have a better assurance of receiving more high quality recruits in their first term force, but this will also increase the cumulative quantity of high quality soldiers required for the Army as a whole, thereby increasing recruiting costs. In some MOSs, a predominately high quality force may not be cost-effective or even required to accomplish all assigned missions. Personnel managers must be able to conscientiously balance their quality mix to meet their mission requirements while at the same time minimizing their cost of personnel procurement.

As we have shown, great effort goes into determining the quality level of a recruit. These time-tested methods of categorizing new recruits as either high quality or low quality help the Army manpower managers place soldiers in an MOS which as closely as possible matches their skill level. How much quality is enough in each MOS and the Army force as a whole is still a question that is being grappled with. With personnel budgets declining at a steady pace, these types of quality mix decisions are crucial in determining the cost and ultimately the combat readiness of the Army.

2. DoD Occupational Code Categories

There are over 250 MOSs in the Army. To help simplify the manpower planner's decision-making activities the DoD has given each Army MOS what is referred to as a DoD Occupational Code (DODOC). These codes are further grouped into one of four broad categories known as DoD Occupational Code Categories (OCCAT). The four OCCATs are:

1) Combat (OCCAT = 1)
2) Very Technical (OCCAT = 2)
3) Technical (OCCAT = 3)
4) Administrative (OCCAT = 4). [Ref. 4, Appx. A]

These categories are of interest to us in our analysis of high quality and low quality soldier performance. Use of the OCCATs allows us to identify a sample of MOSs that provides a good representation of the skill levels and thus the quality mix of our overall population under study. We expand further on this topic in Chapter III when we identify our sample population.

D. PHASES OF A FIRST TERM SOLDIER

Before we begin an analysis of the characteristics and behavior of accession cohorts moving through the Army personnel system, it is important to understand the overall system flow. Recruits do not automatically become technically trained and prepared to perform combat operations upon entry into the Army. A maturation process must take place initially in order for the new recruit to become fully acclimated to the military way of life. This not only includes training in basic combat and survival skills but also the technical aspects the recruit must become fully proficient in before being sent out to an active Army unit.

It is crucial in terms of overall combat readiness and from a cost-effectiveness standpoint to identify early on during this maturation process those recruits who are not meeting up to specified standards of performance. Those in an accession cohort who can not meet these minimum performance requirements, regardless of whether they are a high or low quality recruit, are separated from the Army. The Army's goal is to quickly identify those recruits who do not meet the standards and remove them from the system in order to avoid further expenditures.

There are four phases a soldier must go through in order to continue on through the first term of enlistment. The four phases of the soldier's first term are:

1) Delayed Entry Program (DEP)
2) Basic Combat Training (BCT)
3) Advanced Individual Training (AIT)
4) Sustainment (through remainder of first term).

A basic description of what occurs at each phase is provided below.

1. Delayed Entry Program

The DEP is a program that is used by all the Services to allow for a steady flow of officially contracted recruits into the training base. Contrary to past practices, direct input of recruits into the Army system is not a frequently practiced activity today. Approximately 80% to 90% of all new recruits spend some time in DEP. The maximum amount of time that a recruit can remain in DEP is 12 months. Currently the average time in DEP is 3.9 months.

Reasons for entering DEP are, (1) the recruit wants to finish his or her final semester in high school, or (2) there is a waiting time or queue for the next available training seat [Ref. 11, p. 14]. Another use of the DEP is to screen potential recruits for signs of drug and alcohol abuse and other criminal activities that may appear in local or federal police files [Ref. 12, p. 1]. Because this process takes time and training seats are not always available at the time of enlistment, most recruits are put into the DEP holding pool.

The DEP has advantages and disadvantages for both the recruit and the Army [Ref. 12, p. 2]. DEP is a means by which high school seniors can contract with the Army for post-high school employment and thereby enhance their career opportunities. By signing on early with the Army, prior to any training, the recruit is able to assure himself or herself employment immediately upon graduation. Not only does this motivate the recruit to finish high school but the Army also benefits because they can be assured of receiving a high school graduate. As has already been discussed, HSDGs are more likely to finish out their first term than NHSDGs.

The Army also benefits by using DEP to better manage the input of manpower into the training base over the course of the year. Because the applicants' interests in joining the military tend to be seasonal in nature, with more applicant contracts written in the Spring and early Summer months, DEP allows the Army to moderate the flow of recruits into the training base. Using the DEP as a sort of gate to allow only a certain quantity of recruits to enter the training system at specified intervals ensures that the various training

bases do not become overloaded with too many students. It is extremely important that the timing of the manpower flow into the system be calibrated correctly; otherwise the quality of training could suffer.

We have found that the longer a recruit remains in the DEP (maximum of 12 months) the greater are his or her chances of becoming a "DEP loss." We have also found that the longer one stays in the DEP and in fact enters the active duty force as scheduled, the higher is the probability of that recruit successfully completing their first term of service. This is due to the fact that the DEP acts as a second screening process of recruits prior to their entry into active duty. If they are committed to carrying out their contractual agreement with the Army, they will successfully complete their time in DEP and report for active duty as directed. Those in the DEP who do not have such a strong commitment to their agreement with the Army tend to back out during the DEP period. Even though their reneging on their contractual agreement is not without cost to the Army, it is still considered more cost-effective for these non-committed people to exit the system before many training dollars are spent on them. The loss of a recruit in the DEP is less expensive than the loss of the same recruit halfway through their training cycle.

DEP losses can lead to both financial strain and increased recruiter effort in order for USAREC to meet its annual recruit input requirements. Just meeting actual accession requirements becomes more difficult if the DEP loss rate is significant. Not only could lower-than-projected accessions lead to unfilled positions in the ranks of the Army, but it could also eventually lead to declining readiness rates.

Another interesting characteristic of DEP participants is that high quality recruits tend to renege on their commitment at a higher rate than those in the lower quality category. This phenomenon can be explained by the fact that while in DEP high quality recruits are more likely to find civilian employment that either meets or exceeds the benefits available with an Army enlistment. On the other hand, low quality recruits are more inclined to persist in the DEP because their civilian employment opportunities are not as numerous or the benefits do not meet or exceed those found with a military

enlistment. As more high quality recruits attrit from the DEP recruiters must search for high quality replacements to fill the void. Thus the higher quality recruit's propensity to find employment elsewhere requires the recruiter to exert more effort to find more high quality recruits.

DEP losses cost the Army money. Losses are described in terms of actual money spent during the recruiting process (forms, physicals, travel expenses, etc.) and in terms of recruiter's time and effort expended on each DEP loss recruit (to include average annual recruiter's salary and attached benefits). These costs are all variable in nature so the total loss will increase with an increase in the number of DEP losses.

If a recruit survives DEP, he or she is sent into the Army's training system. For approximately six months, the recruit receives all training required to fully qualify him or her in their assigned MOS.

2. Basic Combat Training

The next step for a recruit who makes it through the DEP (approximately 85% of those originally contracted) is to enter the Army training base. The first step in the Initial Entry Training (IET) cycle is Basic Combat Training (BCT). Here the recruit is introduced to the rigors of basic combat skills, small unit tactics, and survival techniques. The course constitutes the first eight weeks of a recruit's first term in the Army. BCT course costs are considered identical for each soldier because all soldiers, regardless of the training post location, receive identical training. Currently there are four Army posts assigned to the task of conducting BCT.

BCT is a required course for all soldiers entering the Army. The training received during BCT is considered to be MOS immaterial, meaning no MOS-specific skills are introduced. The focus of the program is to teach basic infantryman skills to every recruit. The training is considered more physically demanding than it is mentally demanding. However, some recruits do attrit from the program due to an inability to adapt psychologically as well as not being able to keep up physically.

The average attrition rate for recruits going through BCT is 5%, based on figures compiled for FY 1986 through 1990 cohorts. Compared to DEP losses this is relatively low. One must keep in mind, however, that nearly 15% of the contracted force have already been lost to DEP and most of those losses were individuals not fully committed to succeeding in the military. One thing to consider is that those recruits who do not meet minimum standards can be recycled through BCT if they show strong motivation to try again and their chain of command recommends recycling. This inevitably cuts down on the attrition rate.

When a recruit completes BCT, he or she is shipped to the next step of IET that is known as Advanced Individual Training (AIT).

3. Advanced Individual Training

During AIT the recruit is introduced to the technical aspects of his or her MOS. AIT is considered an apprentice-type training program where a basic recruit is further molded into a technically and tactically trained soldier. Once a recruit graduates from his or her AIT they are considered fully qualified to fill any personnel slot at their grade Army-wide.

AIT typically ranges in length from one to nine months, depending on the MOS's level of complexity. Overall, the average AIT length is four months. For example, a communications equipment repair specialist will spend more time mastering his or her trade than an infantry soldier would. The differences in course lengths and complexity create a variance in AIT course costs from MOS to MOS.

Attrition during AIT will also vary from MOS to MOS. The average attrition rate for a representative population of four MOSs out of the over 250 in the Army inventory was 4% for the FY 1986 through 1990 cohorts. Most of the separations which occur during AIT stem from either a physical failure to perform, discipline problems, or inability to grasp the learning objectives of the technical courses. As in BCT, soldiers in AIT who do not initially meet minimum standards, be they scholastic or physical standards, will normally be recycled. Recycling is considered to be particularly cost-effective at this stage

in the training process because so much time and money have already been invested in the soldier.

It is recognized that higher quality soldiers experience fewer problems scholastically in AIT because they are better able to comprehend and apply the information they are provided during training. Therefore, fewer high quality soldiers attrit or recycle than do low quality soldiers. On the other hand, soldiers with longer AIT courses, usually predominately high quality recruits, have a higher attrition rate than those with a shorter AIT because they are exposed to the risk of training failure for a longer period of time [Ref. 11, p. 27].

If a soldier does not meet the minimum requirements, he or she will either be separated from the service entirely or will be reclassified into another MOS and sent to another AIT course. Reclassification does not occur frequently, mainly because the extra costs for further training will more times than not outweigh the benefits gained in terms of overall Army readiness.

Upon completion of AIT, the soldier is sent to an active Army unit where he or she will finish out the remainder of their first term commitment (approximately 42 months or 3 1/2 years) performing duties related to their designated MOS.

4. Sustainment

After an average time of six months in IET, the fully trained soldier arrives at his or her first unit. It is here that they will serve the remainder of their first term commitment. Soldiers are expected to carry out their technical and tactical duties as learned during IET with assistance from their immediate supervisor. During the next 3 1/2 years, we can see attrition continuing to reduce the total cohort population. This attrition results from soldiers' failure to meet on-the-job performance standards or from disciplinary problems.

Many soldiers do not make it through their first term. Each soldier who exits the system prior to the expiration of their service commitment represents a sunk cost to the

Army. The cost of an attrition is proportional to the unrealized capital return on the Army's recruiting and training investment.

We are interested in determining what causes soldiers to exit or attrit from the system before their allotted time of service has been completed. If attrition trends can be correlated to quality factors, then it stands to reason that different mixtures of quality can produce varying degrees of longevity and force performance. Figure 3 identifies the four phases of the soldier's first term as discussed above in order to allow the reader to visualize the framework in which we are working.

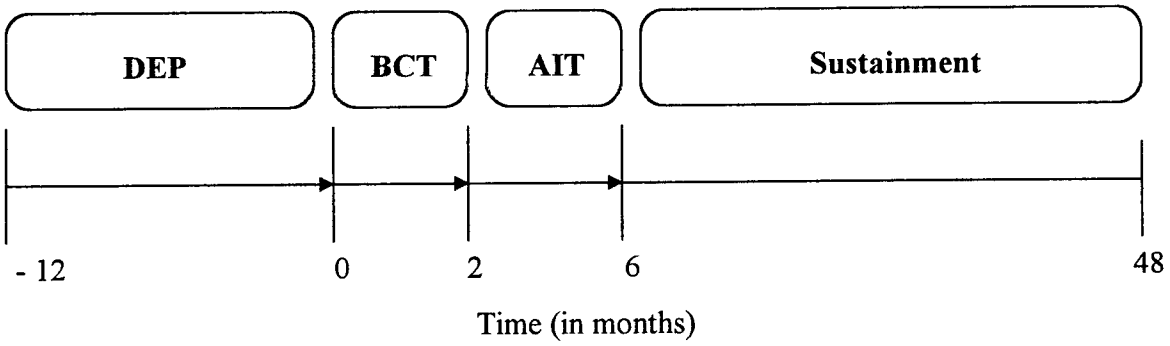


Figure 3. Phases of the First Term

E. REVIEW OF PREVIOUS STUDIES ON QUALITY

Numerous scientific and policy studies have been conducted on the issue of quality in our forces. After the discovery of the misnormed ASVAB tests that allowed thousands of normally unqualified people into military service, members of Congress and the Services began to sit up and take notice. After 1980, recruit quality increased steadily as the Services scrambled to rebuild their personnel force structure.

Throughout this quality build-up period, many policymakers began to wonder if we were recruiting too much quality at a much higher price than necessary. These types of questions spawned countless research projects that began to study the benefits of a force consisting of a larger percentage of higher quality soldiers. These projects have

provided many insights that have been documented in this study because of their relevance to our topic. We introduce three of these studies because their research findings have assisted us in developing our cost models and, in some cases, our conclusions.

1. The Joint-Service Job Performance Measurement/Enlistment Standards Project

The Joint-Service Job Performance Measurement/Enlistment Standards (JPM) Project was initiated by Congress in the summer of 1980 after it was found that the ASVAB was misnormed during the period 1976 until 1980. Because of the larger number of lower quality recruits entering the service during this period, Congress directed that a closer look be taken to verify the "methods used to set enlistment standards and to establish recruit quality requirements." [Ref. 7, p. 1-3] The JPM Project was sponsored by the Office of the Assistant Secretary of Defense (Personnel and Readiness), Directorate for Accession Policy. The project was given a 10 year charter with the specific purpose of attempting to link military enlistment standards to job performance.

The goal of the JPM Project was "to demonstrate the feasibility of using hands-on tests to measure the job performance of enlisted personnel." The project also set out to validate whether using AFQT scores was an adequate way to determine enlisted personnel quality upon entry into the Service through the first term and beyond. The product of the JPM Project was the development of a cost/performance trade-off model to allow military planners to make informed decisions as to the level of quality to recruit on an annual basis. The intent of the model is to link recruit quality to job performance and also to link recruit quality to personnel costs. [Ref. 6, p. v]

It was assumed that enlistment standards could be based on a probability of successful job performance. Based on previous studies conducted attempting to link HSDGs and high AFQT scores to better on-the-job soldier performance, the project members concluded that,

> the better one is able to predict the performance of potential recruits, the lower will be accession and training costs or, analogously, the more

confident one will be of satisfying the performance requirements set by policymakers. [Ref. 7, p. 6-5]

Another study headed by David Armor of the RAND Corporation in cooperation with the Army in response to JPM concerns provided further evidence that aptitude levels are directly related to job performance. The Army developed an on-the-job performance test known as the Skills Qualification Test (SQT) during the early 1980's and administered it to personnel who had been recruited during the misnormed ASVAB years. This study proved that lower-aptitude recruits have significantly lower job performance standards as recorded on their SQT results. It was further proven that high quality soldiers were more likely to meet or exceed minimum job performance standards set by the SQT than their lower quality counterparts. This led JPM Project members to believe that high quality soldiers are more proficient in carrying out their assigned military tasks. So by acquiring larger numbers of lower quality soldiers, overall Army combat effectiveness may suffer. [Ref. 13]

As a result of the of the JPM Project, the committee suggested setting a benchmark figure on quality as follows:

1) a minimum of 90% of new recruits should be HSDGs and,

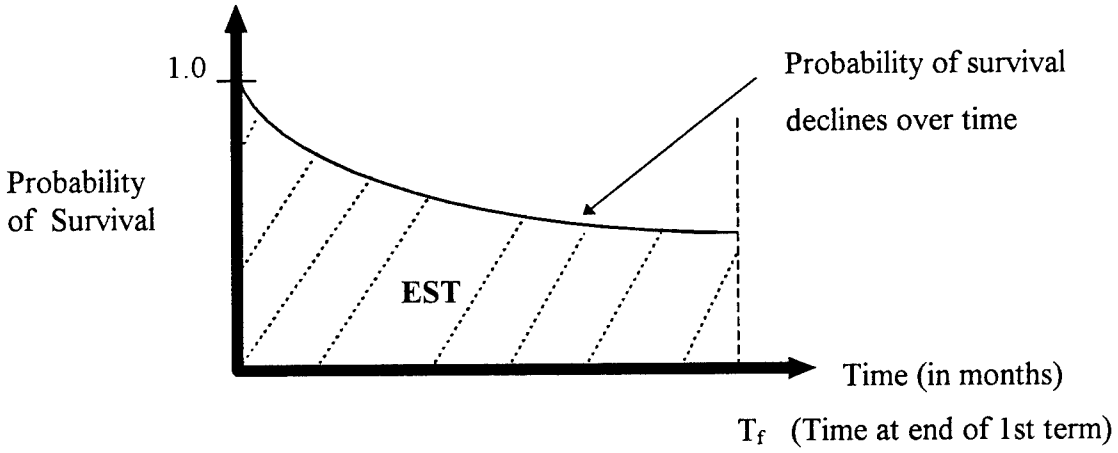
2) a minimum of 60% of new recruits should be CAT I-IIIA [Ref. 6, p. 4].

Interestingly, the Army's minimum recruit quality levels closely approximate the minimum standards recommended by the JPM committee.

The JPM Project has been the catalyst for most of the recruit quality studies conducted since 1980. Many independent and DoD contracted research projects have been used during the development of the JPM Project's Accession Quality Cost/Performance Trade-off Model. Use of this model is not mandatory for DoD organizations as of this date. Even though aspects of its attempt to link enlistment standards to performance are questioned by some, the model and its output certainly deserve further consideration. We feel this model has a direct link to our topic.

2. Expected Survival Time of a Soldier

A study that we also found directly related to ours was conducted by Baldwin and Duala of the U.S. Military Academy in 1984. The emphasis of this study was to capture the pattern of attrition over time to estimate the Expected Survival Time (EST) of a particular "type" of soldier through the first term of enlistment and beyond. They created a model that could show graphically the survival rate of a soldier as depicted in Figure 4 below.



Where EST = Expected man-months of service provided by a recruit

Figure 4. Recruit Survival Curve [Ref. 15, p. 97].

In their model, Baldwin and Duala identify the dependent variable as "time in service at attrition (T)" rather than the probability that a recruit fails to complete his or her first term. They further reason that, "...recruit survival time will influence total steady-state force costs because it affects the number of accessions required per period to maintain a desired force structure." [Ref. 15, p. 98]

By using this method, "We can analyze the cost of attrition by finding the changes in the cost of maintaining a force in the steady-state as we vary the quality of recruits and thereby affect the length of service provided by the typical recruit." [Ref. 15, p. 100] In this way, the EST model has blended well with the intended purpose of the JPM model

mentioned previously and thus fits in well with our study. The techniques used in this model help us to compare different cost consequences related to different quality mixtures. By using these techniques we can determine a more cost-effective mix to recruit by comparing the different attrition rates that correspond to high quality and low quality recruits, respectively.

3. Army Manpower Cost System Active Component Cost Estimation Model

The purpose of the Army Manpower Cost System Active Component Cost Estimation (AMCOS) Model, developed by the Army Research Laboratory and Systems Research and Application (SRA) Corporation, is to provide Army planners with a tool to better analyze manpower costs. The computer model is currently operated and maintained by the U.S. Army Cost and Economic Analysis Center (USACEAC). [Ref. 16, p. 1]

Although the AMCOS model was not specifically designed for determining the optimal quality mix of a recruit cohort, it does provide valuable information as it pertains to a soldier's LCC. We viewed its cost outputs as accurate and have concluded the cost figures fit well with our LCC model. The AMCOS LCC model provides cost information based upon four critical input sources.

1) The first source of information is the Army active component personnel database obtained from DMDC. Stored in this database is an Army manpower inventory of all the personnel in the Army as of FY 1992. The program internally calculates frequency distributions of high quality and low quality soldiers by MOS and rank.

2) Second, the model is linked with what is referred to as the active component budget justification book. The justification book provides pertinent information found in the total Army budget for FY 1994.

3) Third, the FY 1993 military pay and allowance tables are provided.

4) Finally, FY 1988 training cost data is provided. Even though this data is somewhat dated, these actual training cost reports submitted by TRADOC activities have been inflated to FY 1993 dollars.

The AMCOS model provides output data that can be used as we begin to equate costs to LCC activities throughout a soldier's career. We can receive outputs such as LCC estimates for a steady state personnel inventory by rank and MOS. We can also find recruiting costs for high and low quality recruits, as well as the various training costs that take into consideration attrition rates and quality categories.

The costs generated by the AMCOS model appear to accurately reflect Army Regulations and policies. Thus we have determined that we can use these cost equations and their outputs as a starting point in determining LCC in our model.

F. CONCLUSIONS

In this chapter we described how the military Services define quality and why quality is so important to consider when determining how best to shape the combat effectiveness of a cohort. We stressed the importance of quantifying the best mixture of high quality and low quality recruits to determine the most cost-effective force structure.

In the next two chapters, we present methods by which we can calculate LCCs and cost-performance factors.

III. LIFE CYCLE COST MODEL

Now that we have provided the reader with some basic background information on how quality is defined by the Services and how that information is used to place individuals in specific MOSs, we will now delve into the cost of quality. All good things come at some cost, and high quality soldiers in our case are of no exception. Since 1980, military manpower planners have shifted their requirements to a strategy of lowering first term attrition rates by recruiting a proportionally higher percentage of high quality soldiers into the military. It has been reasoned, with good justification based on prior studies, that the extra recruiting costs required to attract more high quality soldiers would be more than offset by the cost savings which would be generated by having lower attrition rates. Even though the Army is recruiting more high quality soldiers, particularly a much larger percentage of HSDGs, the improved quality of the cohort has not led to any significant decrease in recruit attrition rates. [Ref. 11, p. v] As noted by Armor, in a 1982 RAND Corporation study on recruit aptitudes and job performance, "Cost considerations are critical. A force composed entirely of high-quality personnel might be less cost-effective than a mixture of both higher- and lower-quality recruits." [Ref. 13, p. 14]

Although most any leader or manager would rather fill his or her personnel ranks with only high quality workers, the costs associated with the marginal gains received from an additional high quality worker may prove to be cost-ineffective. Therefore, in a world where we must manage our personnel resources within budget constraints, we must be able to estimate as precisely as possible the cost of a high quality recruit and a lower quality recruit as they go through their first term of military service and beyond.

A key issue to consider when determining how many high quality and low quality soldiers to recruit and train each year is the LCC of each representative soldier. We must establish criteria that reflect LCC factors. Consideration must be given to the initial investment in the soldier during recruitment and all other costs incurred throughout the career of that soldier.

Throughout the remainder of this chapter, we discuss the phases of a recruit's life cycle, with emphasis on his or her first term of military service. We observe actual attrition data for selected recruit cohorts in a search for behavioral trends found in the first term.

A. PURPOSE FOR LIFE CYCLE COST ANALYSIS

In order to compare alternatives on a LCC basis, each alternative needs to be broken down into life cycle events. The events are significant activities that occur during the various stages of product development, to include requirements, concepts, system designs and subsequent support requirements. "The life cycle cost analysis needs to be based on a definition of system operational requirements, a definition of the maintenance concept, and a program plan and profile illustrating major life cycle activities and the projected operational horizon for the system." [Ref. 14, pp. 410-411]

At first one may be inclined to believe that these concepts have nothing to do with the recruiting, training, and sustainment of a soldier through his or her first term enlistment in the Army. However, upon closer review of the LCC analysis definition above, one begins to see a relationship. Soldiers in each MOS are given specific operational requirements and are trained according to those requirements. Plans for maintaining the force are set in place and major life cycle activities for a soldier in a given MOS are drawn up to project their operational horizon, which is normally a 20 year career reaching the rank of Sergeant Major (E-9).

In comparing the LCC of a high quality recruit to a low quality recruit, several cost categories are found to be similar for each type of soldier. They are recruiting costs, training costs and sustainment costs. Because these same types of costs appear in both high and low quality soldier's life cycles, this allows us to compare cost differences. The costs are further broken down as shown in Figure 5.

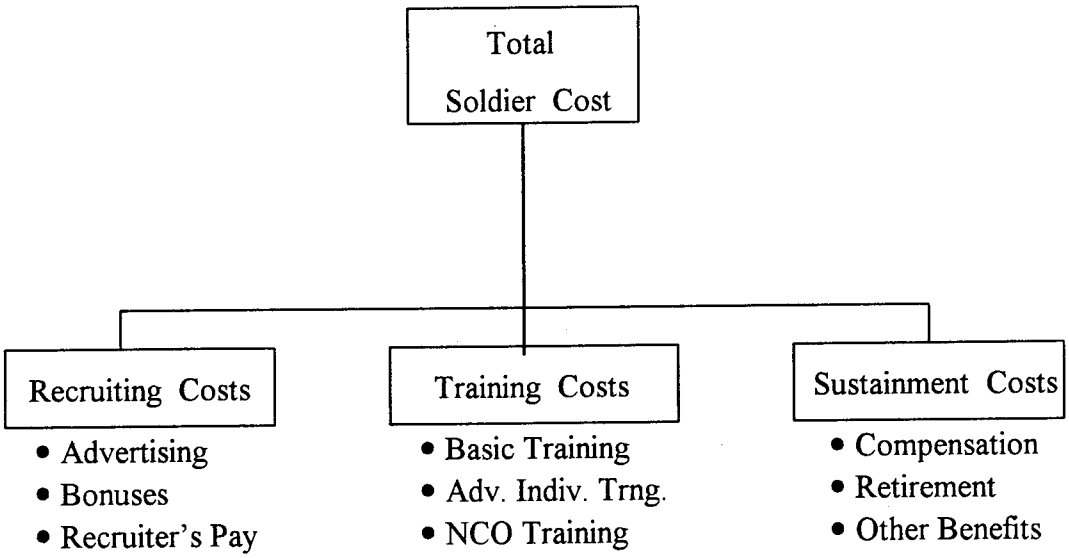


Figure 5. Soldier Life Cycle Cost Categories [Ref. 14, p. 412].

These cost categories can be spread out over time to represent a typical enlisted soldier's flow through the Army system. Variable costs can then be attached at particular periods of time in an effort to determine the total LCC of a soldier over time. Because soldiers in any population possess characteristics that can be observed to allow us to determine an expected survival time for each, we can track the cost of particular types of soldiers throughout their first term or even through a 20 year career.

By collecting information on an accession cohort in terms of particular characteristics, we are able to better predict the LCC and therefore the cost-effectiveness of soldiers of specific characteristic types. So in our LCC model we consider not only the recruiting, training, and sustainment costs but also the attrition rates of the cohort. All of these factors are used to determine on average how many high quality and/or low quality soldiers fall out of the system and when. From this information we determine an estimated LCC for the two quality levels.

B. OBSERVING HISTORICAL TRENDS TO PREDICT FUTURE REQUIREMENTS

A good indicator of adaptation to military life is to compare different quality levels of recruits to their attrition rates over time in service. The best indicator is the first term attrition rates because the greatest percentage of soldiers exit the service during the first term. It is assumed that recruits who attrit before their term of service is complete do so because of their failure to adapt to the military environment. [Ref. 4, p. 9] For purposes of our study, an average first term for a soldier entering the Army is four years in length. Therefore, all calculations and conclusions are based on this assumption.

We will examine historical attrition data to determine if any relationships exist between attrition rates and quality levels. In this section we review data collected on five cohorts through their first term of service in order to track their attrition behavior.

From these trends in attrition we are able to estimate the expected survival time (EST) of a soldier based on certain individual characteristics during their first term. These activities are viewed as necessary steps that must be completed prior to determining an estimated LCC of a high quality or low quality recruit. This effort provides policymakers with a pictorial view of activities which have occurred in the force over time. It is felt that past trends will assist manpower planners in better predicting future first term cohort recruiting requirements. That is precisely the intent of this section.

1. Accession Cohorts Considered

In order to track a cohort's attrition behavior over a period of time, we must go far enough back into the past to cover the span of a four year enlistment of a soldier in a cohort. For this reason, we chose five recruit cohorts that entered the Army during fiscal years 1986 through 1990. These year groups were chosen for several reasons.

1) FY 1986 and FY 1987 were the last two years of the military build-up that occurred under the Reagan Administration. By comparing recruiting results with FY 1988

through FY 1990, we are able to determine if there were any significant recruiting policy changes which occurred after this period.

2) By working with a series of year groups instead of only one sample group, we are able to better understand any trends that may appear over time. If only one year group was used in our analysis, the results would only represent a "snap-shot" in time of Army recruiting and attrition trends.

3) Because the average length of an enlistment in the Army is four years, our data had to go back at least four years in order for us to track attrition and reenlistment trends of the cohorts under consideration. If we relied on more recent data, FY 1991 up to the present time, we would be unable to set a tracking system in place to give us an accurate picture of the life cycle activity of individual soldiers through their first term of enlistment.

As a point of interest, as recently as September 27, 1994, USAREC altered its methods of specifying recruit missions down to the recruiting stations nationwide. In order to simplify monthly missions for recruiters, USAREC reduced the number of mission categories from 20 to just three for the Regular Army component. The three mission categories now in effect are:

1) HSDG and CAT I-IIIA (not gender specific)

2) HS Seniors and CAT I-IIIA (not gender specific)

3) Other (Prior Service, other HS graduates, NHSDGs -- no gender or mental categories specified) [Ref. 17, p. 12].

Clearly, factors that previously defined a high quality recruit in our study are still used. The policy's only real change is that now soldiers will not be recruited based on gender, race, or other characteristics that may be construed as discriminatory. In our analysis, we only examine cohort quality factors (educational status and CAT) so that past trends reflect current policies.

Fiscal Year	Total Accessions	Percent HSDGs	Percent CAT I-IIIA	Percent CAT IIIB-IV
1986	135,764	90.0	62.4	37.6
1987	132,360	90.5	67.7	32.3
1988	113,993	92.8	65.9	34.1
1989	124,192	90.2	63.2	36.8
1990	89,619	94.9	67.1	32.9

Table 5. Cohort Accession Information [Ref. 8].

Table 5 provides the total accessions and their quality factors as a percentage of the total for FY 1986 through FY 1990. As Table 5 shows, total accessions have declined while the percentage of HSDG and CAT I-IIIA recruits have increased. This trend holds true through FY 1994, when total accessions were recorded at just 68,575 and CAT I-IIIAs made up 71% of the recruits.

Figure 6 shows how HSDGs and CAT I-IIIAs have increased from FY 1986 through FY 1994. This increase in the number of HSDGs and CAT I-IIIAs has resulted in a corresponding increase in the percentage of high quality soldiers entering the force.

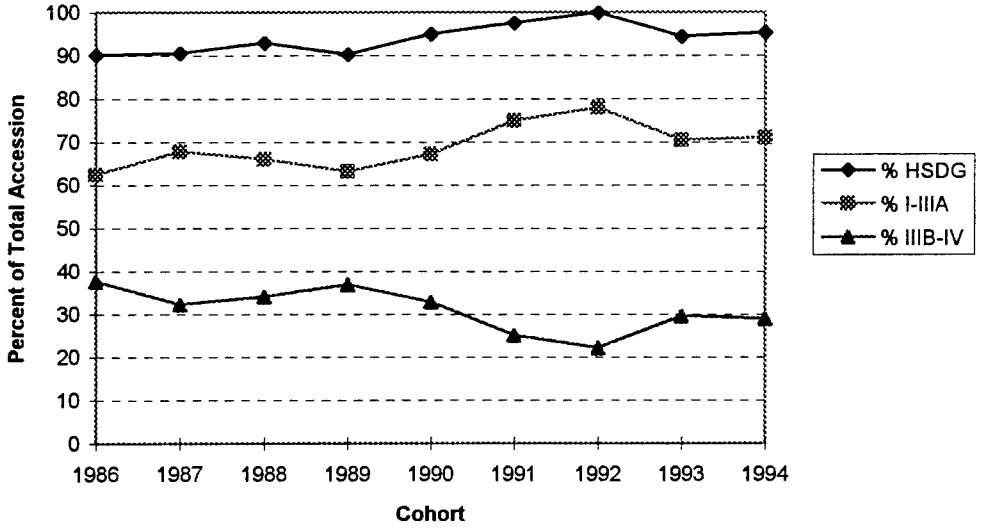


Figure 6. Trends in Quality

Again, for the purposes of this study, we only observe attrition rates and LCCs for FY 1986 through FY 1990. Once we determine the LCC of the force quality mixture for these five populations, we adjust our LCC calculations when considering various other mixtures of quality.

2. Defining an MOS Sub-Population

To simplify our analysis, we worked to decrease the size of the representative population (sum of FY 1986 through FY 1990 totaled 595,928 recruits in over 250 MOSs) while at the same time retaining a statistically reliable database from which to draw reasonable conclusions.

By using the four OCCATs discussed in Section C of Chapter II, we identified a sample of four MOSs that represent the skill levels and thus the quality mix of our overall population. Listed below are the four MOSs we chose as our sample sub-population.

1) Combat -- 13B (Cannon Crewmember)

2) Very Technical -- 91A (Medical Specialist)

3) Technical -- 63B (Light Wheel Vehicle Mechanic)

4) Administrative -- 71L (Administrative Specialist).

This sub-population represents an average of 13% of the total five year population.

Because the finite populations of the year groups considered are very large, we conclude that a subset, or sample, of the population provides us with the information we require to conduct our LCC investigation. A sample survey is conducted instead of considering the entire population for the following reasons:

1) Timeliness is improved because less data is required to be collected and processed.

2) Accuracy is improved because data errors can be controlled better.

3) Detailed information is obtained using this sampling method.

In choosing the four MOSs that we felt best represented the distribution of occupations of the four OCCATs, we used the expert opinions of DoD personnel

managers and our own field experience. We did not use probability sampling methods to choose the MOSs in this case.

Table 6 provides information on the sub-population accession size for each of the cohorts under consideration and their related quality factors as a percentage of the total.

Fiscal Year	Total Accessions	Percent HSDGs	Percent CAT I-IIIA	Percent CAT IIIB-IV
1986	18,566	91.6	63.5	36.5
1987	17,303	92.8	60.9	39.1
1988	14,085	91.6	57.3	42.7
1989	12,983	88.0	52.7	47.3
1990	12,594	94.9	62.1	37.9

Table 6. Sub-Population Accession Information.

Figure 7 shows the quality trends for our chosen sub-population of MOSs. Our visual comparisons of Figures 6 and 7 shows that the sample is a good representation of the population.

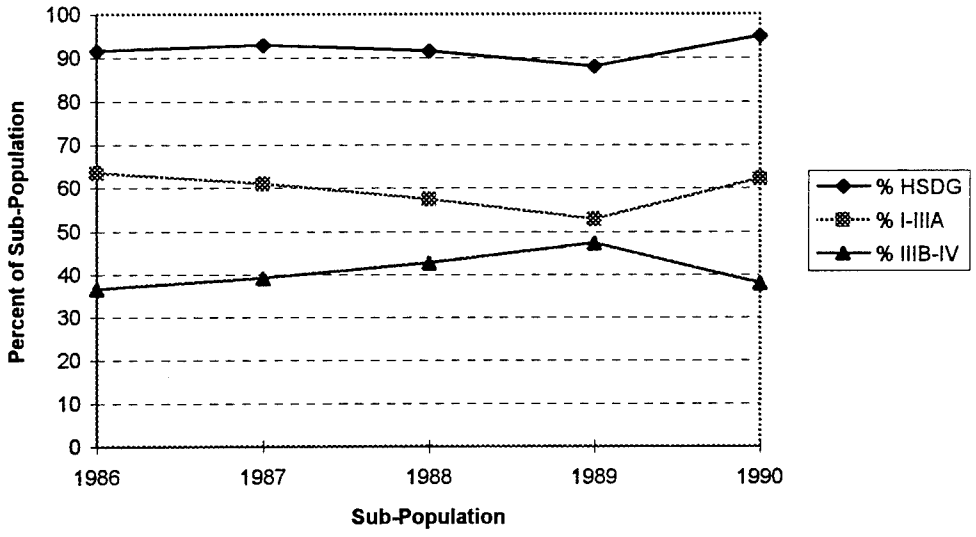


Figure 7. Sub-Population Quality Trends.

3. Recruit Behavior Over Time

As we have seen in the previous sub-section, the Army has put a large effort into increasing its overall quality levels. This trend of building a higher quality force began in earnest in FY 1980 after the ASVAB debacle. Yet since the early 1980's few have looked to see if an increase in recruit quality has led to any tangible benefits.

Greater emphasis is placed on recruiting high quality recruits because they are more likely to finish their first term of enlistment. The rationale is that cost savings are achieved because of fewer attritions. People new into an organization are especially vulnerable to job separation or attrition. [Ref. 11, p. 12] As presented by Baldwin and Duala (1984), we can capture a pattern of attrition over time to estimate the EST of a recruit. In order to capture this pattern of attrition, we need to track the attrition record over the four phases of the soldier life cycle.

Using manpower databases provided by DMDC, we are able to determine the attrition rates of soldiers over the course of their first term of enlistment. By performing this process we can in essence determine the EST of the sub-population over time. We track attrition over time using data the Army considers as qualifying variables for recruitment. The variables are whether the recruit is a HSDG or a NHSDG and what his or her mental category (CAT I-IV) is. We combine these variables to allow us to observe attrition behavior of high quality and low quality recruits. This gives us an indication of how long the two quality categories remain in the system. We assume that there is a greater benefit or return on investment when a soldier, regardless of his or her quality category, remains in the force for a longer period of time. Therefore the duration of a soldier's service becomes a factor of his or her overall cost-effectiveness.

The first phase in our trend analysis is to observe DEP loss rates of a cohort prior to its recruits actually entering the active duty force. Unfortunately, reliable attrition data tracking recruits falling out of the DEP month by month during the allowable 12 months is not available [Ref. 12, p. 7]. USAREC and DMDC only record DEP losses as a

percentage of all contracted recruits that did not access (enter active duty) in a fiscal year instead of on a month by month basis.

DMDC data tracking the number of contracted and accessed soldiers by CAT and education level was only available for FY 1989 through FY 1992. We use this data with the assumption that the trends observed closely reflect the DEP attrition activity which was experienced in FY 1986 through FY 1990. The data from DMDC includes all contracted and accessed recruits from FY 1989 through FY 1992 and not just the MOSs in our sub-population. Table 7 provides demographic information for recruit populations FY 1989 through FY 1992 and also includes forecasted figures for FY 1993.

FY	Quality Level	# Contracted	# Accessed	% Accessed	% DEP Loss	Quality Mix
1989	LQ	53,385	47,532	89.0	11.0	48.7
	HQ	57,006	49,989	87.7	12.3	51.3
1990	LQ	26,643	22,986	86.3	13.7	30.2
	HQ	62,381	53,069	85.1	14.9	69.8
1991	LQ	22,150	19,804	89.4	10.6	29.2
	HQ	54,803	48,069	87.7	12.3	70.8
1992	LQ	17,335	15,570	89.8	10.2	26.6
	HQ	49,223	42,922	87.2	12.8	73.4
			FY 1993	**Forecast**		
1993	LQ	24,017	21,289	88.0	11.4	31.0
	HQ	54,603	47,412	86.8	13.2	69.0

Table 7. DEP Attrition Data [Ref. 18].

The DMDC data on total accessions found in Table 7 shows minor discrepancies compared to that recorded by USAREC found in Table 5. The reason for this anomaly is that recruits who are placed in the DEP toward the end of a fiscal year and not scheduled to enter active duty (access) until the following fiscal year are accounted for by USAREC as either a DEP loss or an accession in the following fiscal year. The DMDC data does

not take these factors into consideration. However, we feel the DMDC data has a small enough sampling error to consider it reliable for use in our trend analysis.

Because we only have four years of reliable DEP loss data available, we consider it necessary to forecast the DEP loss trend out at least one more year in order to estimate the average DEP attrition rate. We use the exponential smoothing technique to forecast DEP loss rates for the short-term. We use an exponential smoothing constant of $\alpha = 0.3$ to track any major changes that may occur. Although the method of choosing the α value of 0.3 is subjective, we want to make the forecast more sensitive to recent changes. Figure 8 shows DEP attrition percentages for FY 1989 through FY 1992, with projected forecast attrition percentages for FY 1993.

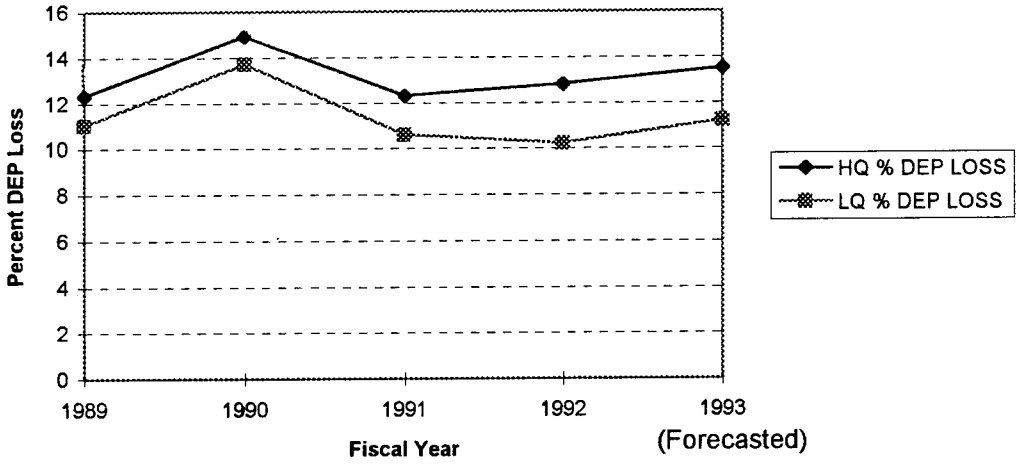


Figure 8. DEP Loss Trends [Ref. 18].

The figure shows that high quality recruits represent a higher percentage of the DEP losses. This trend confirms our earlier conclusions that high quality recruits do account for a larger percentage of overall DEP losses in a contracted population.

From this DEP attrition analysis we can draw several conclusions. The average DEP loss rate for high quality recruits during this time period, to include the FY 1993 forecast, is 13.2% while low quality recruits attrit at a rate of 11.4%. The aggregate DEP loss rate for the period is estimated at 12.6%, including the FY 1993 forecasted numbers.

Because our sub-population quality trends closely reflect the trends of the entire population, we surmise that these average attrition rates for high quality and low quality recruits accurately reflect the DEP attrition activity which also occurred during FY 1986 through FY 1988. These DEP attrition figures can now be built into our LCC calculations. The DEP attrition information is used to determine how many recruits must be contracted to ensure that a sufficient amount reach the training base.

Continuing our analysis, we record attritions of our sub-population for the remainder of the first term. This enables us to determine an average attrition rate in specified increments of time. The plot of these average attrition rates over a four year period is, in effect, the EST of the given population. Table 8 shows how we use year-end retention quantities and convert them into average attrition rates per year. These figures are built into our LCC model to reflect attrition rates over the first term.

	Starts/Accessions	Year 1	Year 2	Year 3	Year 4
1986					
HQ	10,252	8,990	6,626	4,611	3,222
LQ	8,314	7,113	6,200	4,213	3,066
1987					
HQ	9,302	8,188	6,359	4,167	2,966
LQ	8,001	6,986	6,038	4,065	2,936
1988					
HQ	6,895	6,068	4,519	3,443	1,896
LQ	7,190	6,297	5,593	4,756	2,243
1989					
HQ	5,836	5,122	4,484	3,059	1,775
LQ	7,147	6,214	5,432	4,433	2,198
1990					
HQ	7,269	6,325	5,570	3,591	3,280
LQ	5,325	4,574	4,026	3,286	2,883
		Average Attrition Rates			
HQ	39,554	34,693	27,558	18,871	13,139
		0.1229	**0.1804**	**0.2196**	**0.1449**
LQ	35,977	31,184	27,289	20,753	13,326
		0.1332	**0.1083**	**0.1817**	**0.2064**

Table 8. Average Attrition Rates (FY 1986 - FY 1990).

Table 9 shows the average percentage of high quality and low quality soldiers that remain at various increments of time during their first term.

Time Period	High Quality % Retained	Low Quality % Retained
Accession	100	100
BCT	94.88	95.22
AIT	90.99	90.75
12 Months	87.71	86.69
18 Months	83.49	81.22
24 Months	69.67	75.87
30 Months	61.80	71.02
36 Months	47.71	57.70
42 Months	41.83	50.45
48 Months	33.22	37.06

Table 9. Average Retention Rates (FY 1986 - FY 1990).

The average retention rates are calculated using our sub-population database. Figure 9 illustrates the sub-population's retention behavior during their first term.

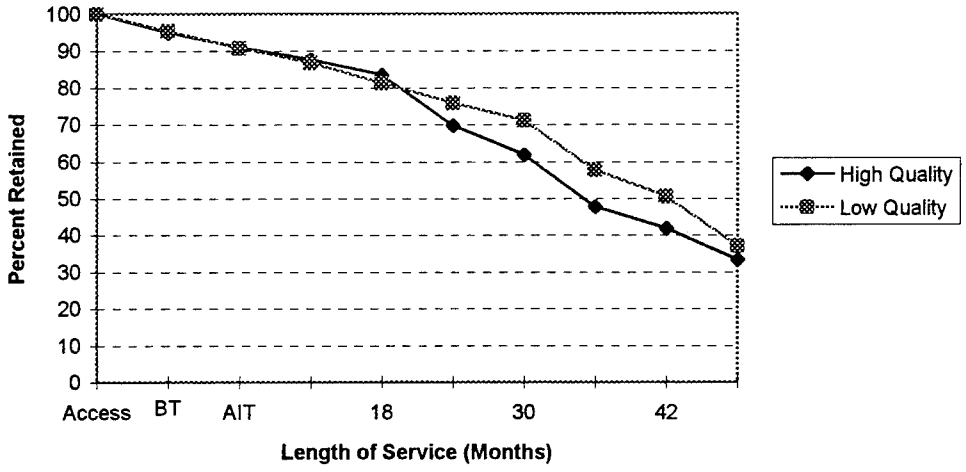


Figure 9. Average Retention Rates for High Quality and Low Quality Soldiers.

It is interesting to note that after approximately 24 months of service, high quality soldiers actually begin to attrit at a faster rate than do low quality soldiers. Further

investigation of statistics on term lengths reveals the cause of this trend. The major contributing factor is that over 25% of high quality soldiers contract for only a two year term of enlistment. This trend can be attributed to the type of recruiting incentives used by USAREC to attract high quality soldiers.

Table 10 illustrates our findings clearly by identifying the percent of high quality and low quality recruits who contracted for various terms (or years) of enlistment.

	Term Length					
	2 Years	**3 Years**	**4 Years**	**5 Years**	**6 Years**	**8 Years**
HQ	25.49	35.13	36.30	1.83	1.09	0.07
LQ	0.29	42.50	56.75	0.10	0.06	0.23
Average	13.49	38.64	46.04	1.01	0.60	0.15

Table 10. Distribution of Enlistment Terms.

Viewing Table 10, we see why high quality soldiers show a higher attrition rate than low quality soldiers.

Researching the issue further we find that a percentage of high quality recruits are offered what is referred to as a "2-by-2-by-4" incentive contract to enlist in the Army. This type of contract provides that in return for college benefits the recruit is obligated to serve two years on active duty, at least two years serving in the Selected Reserve component in a Training Program Unit (TPU), and serve the remainder of the obligation (normally four years) in the Individual Ready Reserve (IRR). Since an average of 25% of all high quality soldiers agree to this type of contract while low quality recruits normally contract for a three or four year term, we will naturally notice a higher attrition rate for high quality soldiers from the active duty force within their first term.

A similar situation exists when we observe retention behavior as a function of a recruit group's CAT level. Figure 10 illustrates that the high-aptitude groups (CAT I-II and IIIA) attrit more than the low-aptitude groups (CAT IIIB and IV). This behavior

compares well with that of the high quality and low quality groupings shown in Figure 9 above.

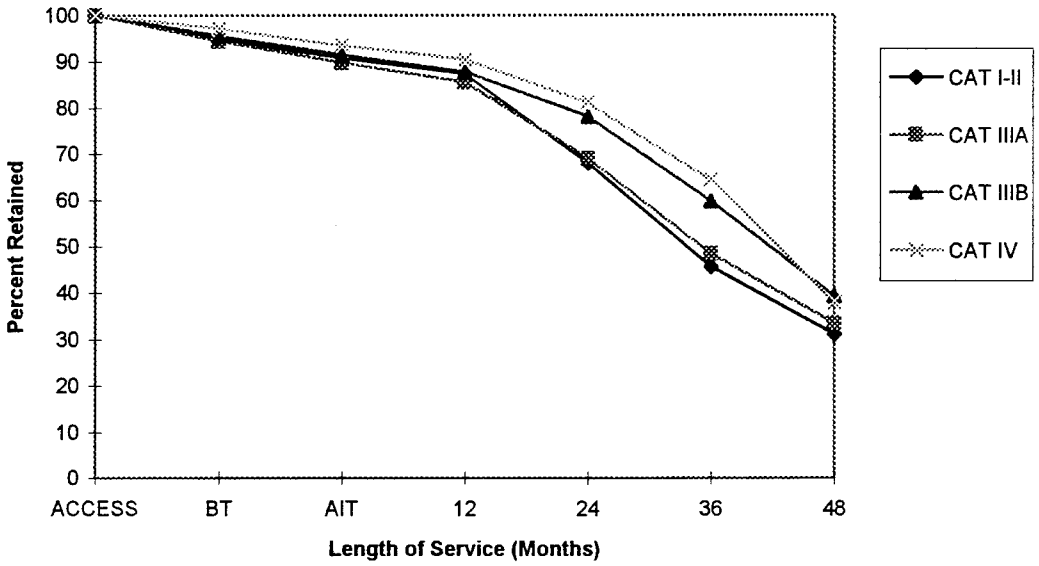


Figure 10. Average Retention Rates by CAT Level.

Consequently, it appears that low quality soldiers are more cost-effective than high quality soldiers in terms of EST and return on the Army's investment to fill the active Army. If this is the case, why are so many military and civilian officials advocating even higher levels of quality for our military personnel structure? Have we chosen an investment strategy which provides a lower return on investment if we continue to recruit greater percentages of high quality soldiers?

Before arriving at such conclusions and changing our military manpower investment strategy, we must go deeper into the issue. To determine the force's cost, we analyze our expenditures in terms of LCC, comparing the costs for a high quality and a low quality soldier. This cost information is one of the many tools available to make rational and informed manpower policy decisions.

C. DEVELOPING THE LCC MODEL

Knowing the attrition rates of high and low quality recruits over time, we combine them with associated annual costs to find the LCC of high quality and low quality soldiers, respectively. Furthermore, by adding these two LCCs, we can determine the total LCC for any force mix we wish to consider. This method of costing out soldiers over time provides decision-makers with a way to view the annual costs of a given force mix of high quality and low quality recruits. By comparing high quality and low quality soldiers in our LCC analysis, we are able to get a clearer picture of what quality mix the Army's manpower dollars are buying.

1. AMCOS Figures Used in LCC Calculations

To conduct our LCC analysis, we combine our sub-population attrition information with costs which are incurred at various phases during a soldier's first term. To determine the numerous costs associated with recruiting, training and sustaining a soldier in the Army, we rely on cost outputs provided by the AMCOS model. With this model we determine average recruiting costs for both high quality and low quality entrants, average BCT and AIT costs, and compensation costs that take into consideration the average promotion rates of soldiers in the active Army.

Table 11 provides a breakdown of these major cost contributors. Note that compensation costs are broken down by pay grade or rank and their values do not vary between high and low quality soldiers.

High Quality	Recruit/DEP	Year 1	Year 2	Year 3	Year 4
Costs					
Recruiting	$10,623				
Training		$19,614			$4,082
Compensation		$9,125	$18,251	$22,440	$22,440
Low Quality	**Recruit/DEP**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Costs					
Recruiting	$7,018				
Training		$19,614			$4,082
Compensation		$9,125	$18,251	$22,440	$22,440

Table 11. LCC Contributors.

Note that high quality soldiers are more expensive to recruit. This is due to monetary bonuses which are given to high quality applicants to attract them into the Army. The recruiting cost for a high quality versus a low quality soldier are figured separately in order to take these and other cost variances into account. In both instances, DEP loss is considered a sunk cost and is not included in the LCC for soldiers accessed into the Army.

Training costs for both high and low quality soldiers are considered equal in the AMCOS model. The total training cost of $19,614 includes both BCT and AIT. All soldiers, regardless of quality level, are allocated the same amount of resources as they make their way through the training phase. Note that training costs also include compensation for the soldier. Because BCT and AIT, on average, make up the first six months of a soldier's time in the Army, we only allocate one half the annual compensation amount in year one to each soldier. This is why year one compensation equals $9,125 and year two compensation equals $18,251.

In year three soldiers are usually promoted to the grade of E-4, thus we see an increase in compensation costs. Finally, year four shows additional training costs which are attributable to what is known as the Primary Leadership Development Course (PLDC). This is a mandatory course which most soldiers attend during their fourth year of service.

2. Cost Adjustments Applied in the LCC Model

We use inflation/deflation factors issued by DoD in order to adjust all of our year-end dollars to FY 1995 constant dollars. These factors can be found in the LCC model in the Appendix.

Because we are conducting a cost-effectiveness analysis, we need to determine appropriate discount factors which can be applied to these constant year-end figures after taking into account inflation/deflation factors. To do this we refer to the real interest rates on Treasury notes and bonds of specific maturities, published in OMB Circular No. A-94, Appendix C (updated) [Ref. 19, Appx. C]. These rates are provided below.

3-Year	5-Year	7-Year	10-Year
2.1%	2.3%	2.5%	2.7%

It is assumed by OMB that these discount rates represent the return on investment if funds are not used to support the Army budget and are instead invested until a specified maturity date.

We use linear interpolation to figure out our real interest rate as specified in the OMB Circular. For our four year investment we evaluate the rate to be equal to the average of the three-year and five-year rates. Thus, we apply a constant interest rate of 2.2% to each year-end LCC value. To determine our year-end discount factors, we used the present value formula:

(3.1) $$PV = 1/(1+r)^n$$

where: r = the real interest rate
n = the year being evaluated.

Once the inflation/deflation rates and real discount rates are applied, we can determine the LCC for any given quantity of high quality and low quality groups of soldiers. Refer to the first spreadsheet found in the Appendix for further details.

3. LCC Spreadsheet Model

The only two factors required to accomplish a LCC calculation using our spreadsheet model are: 1) the percentage of the force the user desires to be high quality and: 2) the manpower end strength required at the end of the four year period. We incorporate these factors into our model because they are the same ones used by manpower managers today to determine cohort force structures.

We conduct a sensitivity analysis to determine how increasing or decreasing the percentage of high quality recruits influences the total LCC of the population. We use a hypothetical scenario which requires an end strength of 35,000 soldiers. The results of our sensitivity analysis show that as we vary the percentage of high quality soldiers making up the force, total LCC changes proportionately. The total LCCs range from $4,901 million with 0% high quality in the force to $5,207 million with a force composed of 100% high quality soldiers.

As an aside, some may be concerned with the possibility that training costs may differ among high quality and low quality soldiers. This difference may be brought about by factors such as instructors having to spend more time teaching technical concepts to low quality students. If we consider that a 1:1.25 learning rate ratio exists between high quality and low quality soldiers respectively, LCC for low quality soldiers would change. To demonstrate this concept, we set our force at 50% high quality and 50% low quality and change low quality training costs to compensate for the slower learning rate. After backing out the compensation costs found in training costs ($19,614 - $9,125 = $10,489), we determine training costs alone to be $10,489. Since there are a total of 71,344 soldiers to be trained (36,479 high quality and 34,865 low quality) for an end-strength of 35,000 soldiers, the total training cost without compensation is $748,327,216 ($10,489 x 71,344 = $748,327,216). If a low quality soldier takes 25% more resources to train than a high quality soldier, then the training cost without compensation is estimated as $11,684 and $9,347 respectively for a low and a high quality soldier ($748,327,216 ÷ (36,479 + 34,865 x 1.25) = $9,347, $9,347 x 1.25 = $11,684). Exercising our model, we come up with a

new LCC for high quality of $673,841,938 (in contrast to $715,499,106 in the reference case) and for low quality of $725,499,278 (in contrast to $683,842 in the reference case). We find that the perceived differences in training abilities increase our LCC for the low quality over the high quality by over $83 million ($725,499,278 - $673,841,938 - ($683,842 - $715,499,106) = $83,314,337).

According to our findings, exclusively recruiting low quality soldiers minimizes our total LCC. This situation exists because low quality soldiers are, on average, less expensive to recruit and remain in the system longer. Therefore, as we increase the percentage of low quality recruits we see a corresponding decrease in the total LCC of the overall population. Refer to the first spreadsheet found in the Appendix for more details.

D. RESULTS AND IMPLICATIONS

We show that low quality soldiers attrit at a lower rate than do high quality soldiers in their first term. Part of the reason for this lower attrition rate is that 25% of the high quality recruits contract for only a two year active duty obligation. Because lower quality soldiers cost less to recruit and remain in the system longer, their LCC is lower than that of high quality soldiers. These findings are contrary to expected results.

By describing and analyzing our population using a somewhat different perspective, we find that the population is composed of roughly 52% high quality and 48% low quality. One may question why the high quality mix is so low, and rightly so. Although the Army is recruiting 95% HSDGs and at least 67% CAT I-IIIAs, the percentage of high quality soldiers recruited per year is not as high as we expected. This anomaly is explained by the fact that not all HSDGs fall into the CAT I-IIIA group. Because, by our definition, low quality represents all others that are not a HSDG *or* CAT I-IIIA, the actual percentage of the force that is high quality is lower than expected.

There is an approximate 6% LCC savings by recruiting an all low quality force. Yet in this case, the cost savings may not justify an abrupt change in our recruiting policies. To put these savings into perspective, the Army's total obligation authority (TOA) for FY 1995 is set at $61.1 billion [Ref. 20, p. 24]. Taking into consideration our

estimated sub-population LCC savings over a four year enlistment of $306 million (the difference between 100% high quality and 0% high quality), this represents only an approximate 0.1% savings/year. The consequence of recruiting and retaining more low quality soldiers to try to save money is a decrease in overall combat effectiveness. Past studies reveal that low quality soldiers provide proportionately lower levels of performance than their high quality counterparts [Ref. 6, p. 38]. Thus the cost savings associated with more low quality soldiers may not be worth the decrease in job performance.

We must therefore take into consideration factors such as a soldier's hands-on performance capabilities when he or she is sent out to the active Army. Since soldiers must be capable of accomplishing their wartime missions on short notice, hands-on performance should be considered as a critical factor in determining an appropriate force quality mix and ultimately the combat effectiveness of the Army.

In the next chapter, we explore the aspect of hands-on performance as related to soldier quality. The intent is to build on past research in an attempt to stimulate new thoughts on the topic of performance and how it relates to quality.

IV. ADJUSTING COSTS FOR PERFORMANCE

As we found in Chapter III, from a purely "cost minimization" perspective it is best for policymakers to recruit only low quality people to fill the lower enlisted ranks of the Army. An organization that strictly adheres to a cost-minimization policy in the area of personnel recruitment will more than likely minimize themselves out of business. The Army is no exception.

We recognize that the Army is subject to certain quality constraints as mandated by Congress and mentioned in Chapter II. Army manpower managers must deal with these quality constraints and the associated cost constraints when building the force. To assist policymakers in this process, we must find a way to analyze the force's LCC in terms of marginal costs. This will define what the true cost of one additional high quality or low quality soldier is as we design future force structures. By determining the cost-effectiveness of a recruit over his or her life cycle, the marginal LCC (MLCC) of the recruit can be derived. By comparing MLCCs for high and low quality recruits, we can determine which type of soldier is actually less expensive in terms of a performance-adjusted MLCC.

A. PURPOSE OF COMPARING COST TO PERFORMANCE

Rather than simply try to minimize our LCC, we should try to maximize our soldier work output. The Army's mission is to fight and win our nation's wars quickly with the fewest casualties possible. To accomplish this mission, the soldiers operating our modern weapon systems and those leading them must possess an adequate degree of competence to ensure effective execution of their assigned tasks.

The JPM Project, as introduced in Chapter II, was initiated for these reasons more than a decade ago. One of the project's main goals was to establish a relationship between the quality level of a soldier and his or her actual job performance in the field. By establishing such a relationship it was felt that manpower planners could better adjust and justify the quality mix of the force structure.

Although all may not agree with the project's conclusions, their findings seem to parallel the efforts of our study. We integrate some of the project's findings into our LCC calculations and apply performance factors to determine the LCC per man-year (LCC/man-year). Because personnel performance is critical to the accomplishment of Army missions, it most certainly should be included in any decision-making process to determine how much high quality is sufficient for overall combat effectiveness.

B. THE COST OF QUALITY PER MAN-YEAR

Besides considering the total LCC of a high quality versus a low quality soldier, we also consider his or her overall contribution to the Army in terms of productive work output. Although a low quality soldier may be less expensive in terms of LCC, his or her level of work output and performance may be lower than that of a high quality soldier. Most would agree that a low quality soldier possess a lower level of performance than a high quality soldier, but quantifying these differences in terms of dollars can be a difficult task. Our intent is to assign costs to a soldier based on his or her quality level to define what we call a LCC/man-year figure. Once we establish such figures for both high quality and low quality soldiers, we compare these average sustainment costs per soldier per year.

First we calculate the man-years contributed by our sub-population. Total man-years contributed over the course of the first term for the entire cohort are calculated in order to quantify a measure of performance (man-years of service) with a LCC. In this way, we determine the LCC/man-year of the cohort in terms of its quality mixture. The LCC/man-year of the cohort is useful because it provides us with insight into how much a soldier costs in comparison to his or her level of performance.

To calculate the man-years contributed by the cohort of high quality and low quality soldiers over four years, we first determine the average inventory of soldiers in the cohort from year to year. We use the average inventory per year instead of the year-end population value in order to factor in a portion of the man-years that are contributed by those soldiers who attrit during the year. This provides a more accurate representation of actual man-years contributed by the cohort per year.

Adding the average inventory levels gives us our total man-years for both high quality and low quality soldiers. We determine the LCC per man-year of a high quality and a low quality soldier by dividing respective LCCs by the number of man-years contributed. This LCC/man-year provides us with the LCC/man-year figure per type of soldier. With our sample population having an end-strength of 35,000 and a 50-50 force mix of high quality and low quality soldiers, the LCC/man-year for a high quality soldier is $24,637 and $23,248 for a low quality soldier. Refer to the first spreadsheet found in the Appendix for the factors contributing to these values.

We see that without any adjustments made for performance low quality soldiers are again found to be, on average, less expensive to sustain per year than high quality soldiers. In the next several sections, we consider hands-on performance and its effects on the man-years contributed by both the high quality and low quality portions of the cohort.

C. RESULTS OF HANDS-ON PERFORMANCE TESTING

In the early 1980's members of the JPM Project group developed hands-on performance tests (HOPT) for 30 jobs in all four Services. These tests were administered to first term enlistees to determine if there was a relationship between the various levels of quality (measured by CATs) and improvement in hands-on performance as a function of job experience or length of service [Ref. 6, p. 20]. Of nine Army MOSs represented in this study, the four MOSs of our sub-population are present. Again these specialties are, 1) Cannon Crewman, 2) Light Wheel Vehicle Mechanic, 3) Administrative Specialist, and 4) Medical Specialist [Ref. 7, p. 2-2].

The results were compiled and converted to have a mean score of 50. These results are shown in Table 12 below.

Job Experience (Months)		CAT I-II	CAT IIIA	CAT IIIB	CAT IV
1-12	Mean	49.3	45.6	43.7	39.7
	SD	9.5	10.0	8.6	9.0
	N	192	144	284	98
13-24	Mean	52.0	48.8	47.7	46.1
	SD	9.4	9.6	9.6	9.5
	N	1,452	1,046	1,244	525
25-36	Mean	53.2	50.5	49.9	47.1
	SD	9.3	9.9	9.4	9.5
	N	680	547	655	213
37+	Mean	54.6	52.5	50.8	48.9
	SD	8.5	9.5	9.5	8.3
	N	660	395	525	125
Total	Mean	52.6	49.8	48.4	46.0
	SD	9.5	10.0	9.7	9.6
	N	2,984	2,132	2,708	961

Table 12. Mean HOPT Scores by Aptitude and Job Experience Levels for 30 Jobs [Ref. 7, p. 2-4].

Table 12 shows that soldiers in a higher CAT level consistently score higher on the HOPT than those in a lower CAT level. As illustrated in Figure 11 this situation holds true even as job experience levels increase (as measured in length of service).

Figure 11. Job Performance and CAT Level [Ref. 6, p. 20].

It can be drawn from Figure 11 that a relationship does exist between the various CAT levels and their HOPT scores. As a soldier spends more time in the service performing in his or her MOS, they become more proficient at their trade. The JPM Project group noted that, "Performance of the low-aptitude group lags behind the high-aptitude group's performance, no matter how many months of on-the-job experience have accrued." [Ref. 7, p. 2-2]

Because a type of relationship does exist between the various CAT levels, we can draw some conclusions from the HOPT scores. Looking at Figure 11, we can identify certain performance-related trends. For example, although a CAT IV soldier always lags behind all the other CAT levels, he or she tends to climb to the initial skill level of a CAT I-II soldier after four years of experience or to the skill level of a CAT IIIA with two years of experience.

Therefore, we conclude that the mean HOPT scores recorded by the JPM Project group can be used to develop ratios of performance as pertains to the various quality levels of soldiers. With these hands-on performance factors, we can determine an estimated cost-effectiveness value for either a high quality or a low quality soldier as determined by their annual cost (LCC/man-year) and their effectiveness during their life cycle as measured by man-years contributed.

D. DEVELOPING PERFORMANCE FACTORS

To develop our performance factors that are used to derive effective man-years of performance for both high quality and low quality soldiers in a given cohort, we first convert the mean HOPT scores to simple ratios of performance as compared to a benchmark.

The benchmark we chose is the mean HOPT score of the CAT I-II population with +37 months of job experience. Because this was the highest score, we convert all the other scores for the various CATs and job experience levels to a percentage of our benchmark. For example, we define the ratio of a CAT IV soldier with one year of service

as 39.7/54.6 = 0.727. Table 13 provides our initial performance factors that are defined by CAT and years of job experience.

	Year 1	Year 2	Year 3	Year 4
CAT I-II	0.903	0.952	0.974	1
CAT IIIA	0.835	0.894	0.925	0.962
CAT IIIB	0.800	0.874	0.914	0.930
CAT IV	0.727	0.844	0.863	0.896

Table 13. Mean HOPT Scores for CATs Converted to Performance Factors.

As an interpretation of Table 13, a CAT IIIB soldier with two years of experience, for example, is considered to be 87.4% as effective as the benchmark CAT I-II soldier with four years of experience.

To have our newly developed performance factors coincide with the previous sections of our study, we define our performance factors in terms of high quality and low quality. As illustrated in Figure 10 in Chapter III, CAT attrition behavior corresponds well with a given level of quality. Thus we surmise that high-aptitude soldiers (CATs I-II and IIIA) and low-aptitude soldiers (CATs IIIB and IV) can be categorized as high quality and low quality soldiers, respectively. Since the HOPT only identified mean scores by CATs, we conclude that we can convert these CAT groupings into high quality and low quality categories by simply assuming that all incoming recruits are HSDGs. This assumption is not far from reality considering the fact that USAREC is currently recruiting HSDGs at a level of 95% and above. By assuming all recruits are HSDGs, we are able to find average HOPT scores for high quality and low quality soldiers. Table 14 shows the mean HOPT scores adjusted to high quality and low quality categories.

	Year 1	Year 2	Year 3	Year 4
High Quality (CAT I-II + IIIA)	47.5	50.4	51.9	53.6
Low Quality (CAT IIIB + IV)	41.7	46.9	48.5	49.9

Table 14. Mean HOPT Scores Adjusted for Level of Quality.

Finally, Table 15 shows the results of converting these mean HOPT scores to performance factors in the same manner as before.

	Year 1	Year 2	Year 3	Year 4
High Quality (CAT I-II + IIIA)	0.886	0.940	0.968	1
Low Quality (CAT IIIB + IV)	0.778	0.875	0.905	0.931

Table 15. Mean HOPT Scores for Quality Levels Converted to Performance Factors.

E. LIFE CYCLE COSTS ADJUSTED FOR PERFORMANCE

Now that we have developed our performance factors table for high quality and low quality soldiers, we are ready to apply these factors to our LCC model. By adjusting our average annual inventory values using our performance factors, we determine the average man-years contributed by high quality and low quality soldiers based on their level of performance. Refer to the second spreadsheet found in the Appendix for further details.

By building performance factors into our LCC model, there is a decrease in the total man-years contributed by both high quality and low quality groups. As stated earlier, performance is a function of job experience. As soldiers, regardless of their quality level, spend more time working in their MOS their level of performance increases proportionally.

Adding up the man-years adjusted for performance, we find that the total man-years contributed by high quality soldiers is 99,285 and by low quality soldiers is 90,918. These performance-adjusted man-years reflect the different attrition rates and performance rates for the four year period.[1] Dividing our constant LCCs for high quality and low quality by their new man-year contributions, we come up with somewhat different results for LCC/man-year. We find that high quality soldiers are more cost-effective in terms of LCC/man-year with an average annual expense of $26,224 as compared to $26,953 for a low quality soldier. Conducting a sensitivity analysis, we find that these performance-adjusted LCC/man-year figures remain constant along the entire range of high quality force percentage mixes. The LCC/man-year figures adjusted for performance represent the average LCC per year for high quality and low quality soldiers, respectively.

To compare our findings to our original LCC calculations in Chapter III, we determine the LCC savings associated with recruiting 100% low quality soldiers. We hold the four year end-strength constant at 35,000 soldiers. With a benchmark force composed of 100% low quality soldiers, our non-performance-adjusted LCC is $4,091 million as determined in Chapter III. Next we determine how many high quality soldiers are required to match the 35,000 low quality soldiers in terms of performance-adjusted end-strength. Referring to Table 16, we see that a low quality soldier is 93.10% as effective as a high quality soldier. This percentage difference in effectiveness indicates the performance differential that exists between a high quality and a low quality soldier at the four year mark. We find it will take 32,585 high quality soldiers (35,000 x 0.931) to match the effectiveness of 35,000 low quality soldiers. The savings in the number of high quality soldiers required to be recruited (2,415) equates to a lower LCC for a force made up of 100% high quality soldiers. The new LCC for 32,585 high quality soldiers is $4,848 million, equaling a LCC savings of $53 million ($4,901 million - $4,848 million).

We now identify our benchmark to represent an end-strength of 35,000 high quality soldiers with a non-performance-adjusted LCC of $5,207 million. If we take the

[1] The detailed derivation of these man-year figures is found in the second spreadsheet in the Appendix.

reciprocal of the percentage effectiveness of the low quality soldier (1/0.931) we find that it takes around 1.07 low quality soldiers to match the performance capability of one high quality soldier. Through similar calculations we find that it takes 37,594 low quality soldiers (35,000 x 1.074114) to match the 35,000 high quality soldiers in terms of performance-adjusted end-strength. Here we find that the new LCC for 37,594 low quality soldiers is $5,264 million. In this scenario we discover the LCC savings of recruiting 100% high quality soldiers is $57 million ($5,264 million - $5,207 million).

In both scenarios, when man-years are adjusted for performance, the LCC for a 100% high quality cohort is lower than that of a 100% low quality cohort. Thus we now find that high quality soldiers are more cost-effective when we consider adjustments for performance in our LCC calculations. However the relationships presented here should be interpreted with caution. The cost estimates only hold true within a limited range of cohort quality mix ratios.

F. DETERMINING MARGINAL LIFE CYCLE COST

As a final step in our analysis, we determine the MLCC of both high quality and low quality soldiers and compare the results. MLCC is defined as the difference in LCC due to a unit increase in performance-adjusted end-strength. The MLCC provides important cost information that can assist manpower planners in determining how best to allocate their scarce financial resources. In our study, we derive our MLCC using the performance factors presented earlier.

The MLCC for a high quality soldier is determined by finding the difference between our original LCC for 17,500 high quality soldiers (benchmark) and the new LCC when the high quality force is increased by one. The MLCC for a low quality soldier is determined in the same manner except that the low quality force end-strength is increased by 1.074114 (the reciprocal of the percentage effectiveness of the low quality soldier (1/0.931)). This greater end-strength requirement causes the low quality soldier's MLCC to become greater than the high quality soldier's MLCC.

Expressing our process using equations, we have:

(4.1) $MLCC_{HQ} \equiv$ LCC(No. of HQ = 17,501) - LCC(No. of HQ = 17,500)

(4.2) $MLCC_{LQ} \equiv$ LCC(No. of LQ = 17,501.074114) - LCC(No. of LQ = 17,500).

The results of our analysis show that to increase the established end-strength by one soldier, the MLCC for a high quality soldier is $148,773 and for a low quality soldier it is $150,399. This indicates that increasing the performance-adjusted high quality end-strength by one soldier is 1.08% less expensive in terms of his or her MLCC than one additional low quality soldier. These findings also support the argument that high quality soldiers are more cost-effective on the margin.

G. CONCLUSION

As presented in Chapter III, when we only consider LCC without adjustments for performance, we find that the high quality group's total LCC is $150 million more than the low quality group's total LCC.

However, we find through the comparison of LCCs after adjustments are made for performance that a 100% high quality cohort is more cost-effective over its life cycle than a 100% low quality cohort. When we compare a benchmark of 35,000 low quality soldiers to a performance-adjusted equivalent of high quality soldiers (32,585) we realize a LCC savings of $53 million. Similarly, comparing a benchmark of 35,000 high quality soldiers to a performance-adjusted equivalent of low quality soldiers (37, 594) results in a LCC savings of $57 million. These savings occur because fewer high quality soldiers are needed to contribute the same number of man-years during the four year life cycle.

When we apply performance adjusted factors to our LCC model, we also find that the MLCC of a high quality soldier is less than that of a low quality soldier. Therefore if we need to increase our established end-strength by one additional soldier, we are better off recruiting a high quality soldier because of their lower MLCC.

These results should be given serious consideration by manpower planners when they make their annual projections for force quality requirements under existing quality and cost constraints.

V. SUMMARY / CONCLUSIONS / RECOMMENDATIONS

A. SUMMARY

During this study we derive the LCC of both high quality and low quality soldiers. By performing a LCC analysis, one considers all of the costs that contribute to the total cost of a soldier over his or her life cycle. The LCCs that are not adjusted for performance show that low quality soldiers have a lower LCC than high quality soldiers. However, when we adjust our established end-strength for performance, we find that the LCC for high quality soldiers is less than that of low quality soldiers. Using the same performance-adjusted factors we also find that the MLCC of a high quality soldier is less than the MLCC of a low quality soldier.

Throughout this study, we worked to answer our initial research questions. Here we answer each question separately based on our findings.

1) What relationship, if any, exists between the quality level of a recruit and his or her LCC? It is apparent through the use of a LCC analysis that a high quality soldier has a greater LCC than a low quality soldier. We find that with a cohort requiring an end-strength of 35,000 soldiers and consisting of a 50-50 mix of high and low quality, the high quality portion's LCC is approximately $150 million more than the low quality portion. This greater cost is attributable to factors such as higher recruiting costs and higher attrition rates over a first term enlistment for high quality soldiers. When the LCC/man-year is not adjusted for performance, a high quality soldier's annual sustainment cost is also greater than that of a low quality soldier.

2) What potential LCC savings are there, if any, if the quality mix is adjusted to allow for more low quality soldiers? We find that as the percentage of low quality soldiers increases, the total LCC for the cohort decreases following a linear pattern. This pattern is due to the AMCOS cost assumptions used in the computations. Thus we find the lowest LCC at the point where low quality soldiers make up 100% of the population. The cost savings realized by recruiting 100% low quality soldiers is $306 million over a four year period. However, the savings figure must be treated with caution because of the

above mentioned linearity assumption. In addition, these figures are not adjusted for performance.

3) Is there a relationship between a recruit's quality level and his or her hands-on performance capability? If so, what influence does a soldier's performance capability have on his or her LCC? We find that the high quality soldiers (CAT I-II and IIIA) consistently score higher during a hands-on performance test than do low quality soldiers (CAT IIIB and IV). We also discover that performance capabilities for both quality levels improve over the life cycle of a soldier. Using our LCC spreadsheet model, we determine that performance factors can be used to adjust the total man-years contributed by high and low quality soldiers. We find that the performance-adjusted end-strength LCC for high quality soldiers is less than that of low quality soldiers. In one scenario we find that the LCC savings realized by recruiting a 100% high quality cohort as opposed to a 100% low quality cohort is $53 million. This cost savings is realized because we need only 32,585 high quality soldiers to equal the man-years of work of 35,000 low quality soldiers.

4) What is the MLCC of a high quality and a low quality soldier? We define the MLCC as the difference in LCC due to a unit increase in performance-adjusted end-strength. If we increase our established end-strength total by one soldier, we find that it will take about 1.07 low quality soldiers to match the performance capability of one high quality soldier. We determine the MLCC of a high quality soldier is 1.08% lower than that of a low quality soldier ($148,773 versus $150,399 respectively).

B. CONCLUSIONS

This study reveals some unexpected results in terms of attrition rates and LCCs. Prior to analyzing any data we assumed that the LCC of a high quality soldier over the first term would be less than that of a low quality soldier when no adjustments were made for performance. This assumption was predominately based on the idea that low quality soldiers would attrit at a higher rate than high quality soldiers. To our surprise, we find just the opposite to be true. High quality soldiers do not stay on active duty as long as low quality soldiers do because over 25% of high quality soldiers have only contracted for

a two year term of enlistment. This high loss at 24 months of service (only 18 months after IET) is the biggest contributor to the high attrition rates for high quality soldiers.

Because of their higher attrition rates and their higher recruiting costs, the high quality portion of the cohort usually has a higher LCC than the low quality portion of the cohort if there are no adjustments made for performance. We might see a shift in our total LCC results favoring a larger proportion of high quality soldiers if high quality recruits were not allowed to leave active duty after only two years.

We interpret HOPT scores found during the JPM Project into what we term performance factors. Because high quality soldiers contribute more performance-adjusted man-years to the force, we find that high quality soldiers are more cost-effective than low quality soldiers when we adjust our LCCs for performance. We also conclude that high quality soldiers have a lower MLCC than do low quality soldiers when LCCs are adjusted for performance.

Contrary to popular belief there are more low quality soldiers recruited into the Army than most people realize. A random sample we use in our study is composed of nearly 50% low quality soldiers. Although no quality demographics are available for a total recruit population in terms of this study's definitions of high and low quality, we assume that our sample is a good representation of the total recruited population. Although the Army is recruiting record high levels of CAT I-IIIAs (67% and above) and record low levels of CAT IVs (2% and below), they are recruiting an average of 33% CAT IIIB soldiers that are classified as low quality.

C. RECOMMENDATIONS

Considering all of our findings, we make four recommendations.

1) Incorporate LCC analysis techniques into future manpower policy studies. A LCC analysis provides a concise, step-by-step process by which costs can be captured and analyzed on an annual basis. Performing a LCC analysis makes it easier to compare several alternatives and choose the one that is more cost-effective.

2) Primary consideration should be given to the performance of a soldier in future manpower studies. The performance level of a soldier impacts his or her combat readiness. Incorporating performance factors into a LCC analysis reveals the true cost-effectiveness of the soldier.

3) It is recommended that high quality be maintained at a level of at least 50% of the cohort recruited per year in order to take advantage of both the cost-effectiveness of high quality soldiers and the cost savings associated with low quality soldiers. Realistically, the Army cannot be composed entirely of low quality soldiers because of performance inefficiencies that would exist or of high quality soldiers because of budget constraints.

4) The Army should explore implementing a mandatory four year service obligation for all high quality soldiers. This may increase the active Army's return on investment. By enforcing such a policy, fewer high quality soldiers will be required to meet the target end-strength. This will decrease the recruiting costs and the associated sustainment costs. A study should be conducted to determine the effects of such a policy on the propensity of high quality applicants to enlist and the expected decline in the supply to the Selected Reserves.

D. FURTHER STUDIES

The potential for further studies on this topic are numerous. Two are suggested here:

First, we suggest a similar study be conducted incorporating LCC analysis and cost-performance factors using entire accessed populations instead of only a sample population. Although we feel our sub-population was a good representative sampling of the entire cohort, considering the entire range of MOSs may show different results in attrition and high and low quality distributions. This would also help to validate our model.

Second, we suggest further studies to track those who have left active duty to assess whether or not they serve in the Reserve Component (RC), be it the Selected

Reserves, the National Guard, or the IRR. Such a study would provide insight into the long term effect of lengthening (or shortening) the active duty term for prospective high quality soldiers. This information is critical as the roles and missions of the RC increase.

APPENDIX. LCC CALCULATIONS

This appendix shows output information derived from our LCC spreadsheet model. Spreadsheet Number 1 provides detailed information on LCC calculations which are discussed in Chapter III. This spreadsheet contains no adjustments for performance factors. Spreadsheet Number 2 provides figures related to concepts we discuss in Chapter IV. The LCC calculations in this spreadsheet are adjusted for performance. Spreadsheet Number 2 also contains MLCC information for high quality and low quality soldiers.

Spreadsheet No. 1
LCC Calculations
(No Adjustments
for Performance

		1	2	3	4	5
			LCC High Quality Force			
	Required Contracts	Access/DEP	Year 1	Year 2	Year 3	Year 4
Attrition %		0.1320	0.1229	0.1804	0.2196	0.1449
Number of Soldiers	42,027	36,480	31,996	26,224	20,465	17,500
Average Inventory (Mid Year)			34,238	29,110	23,345	18,983
Cost (FY 93 $)						
Recruiting		$387,525,247				
Training			$627,578,566	$0	$0	$71,435,000
Compensation			$291,967,697	$478,619,674	$459,244,533	$392,700,000
Total (FY 93 $)		$387,525,247	$919,546,264	$478,619,674	$459,244,533	$464,135,000
Inflator/Deflator (FY 95 $)		1.0330	1.0191	1.0000	0.9794	0.9559
Constant FY 95 $		$400,313,581	$937,109,598	$478,619,674	$449,784,095	$443,666,647
Discount Factor	2.20%	1.0000	0.978473581	0.957410549	0.936800929	0.916634960
Discounted Cost		$400,313,581	$916,936,984	$458,235,525	$421,358,158	$406,680,359
LCC		$2,603,524,606				
			LCC Low Quality Force			
	Required Contracts	Access/DEP	Year 1	Year 2	Year 3	Year 4
Attrition %		0.1140	0.1332	0.1083	0.1817	0.2064
Number of Soldiers	39,351	34,865	30,221	26,948	22,051	17,500
Average Inventory (Mid Year)			32,543	28,584	24,500	19,776
Cost (FY 93 $)						
Recruiting		$244,680,598				
Training			$592,749,563	$0	$0	$71,435,000
Compensation			$275,764,238	$491,824,890	$494,833,669	$392,700,000
Total		$244,680,598	$868,513,801	$491,824,890	$494,833,669	$464,135,000
Inflator/Deflator (FY 95 $)		1.0330	1.0191	1.0000	0.9794	0.9559
Constant FY 95 $		$252,755,058	$885,102,415	$491,824,890	$484,640,096	$443,666,647
Discount Factor		1.0000	0.978473581	0.957410549	0.936800929	0.916634960
Discounted Cost		$252,755,058	$866,049,330	$470,878,338	$454,011,292	$406,680,359
LCC		$2,450,374,376				
		Representitive Force LCC (Four Year Life Cycle)				
	%	End Strength	LCC ($M)	ManYears	LCC/End Strength	LCC/Man-Years
HQ	50%	17,500	$2,603,524,606	105,676	$148,773	$24,637
LQ	50%	17,500	$2,450,374,376	105,402	$140,021	$23,248
Total	100%	35,000	$5,053,898,982	211,078		
		AMCOS Figures for LCC				
High Quality	Recruit/DEP	Year 1	Year 2	Year 3	Year 4	
Costs						
Recruiting	$10,623					
Training		$19,614			$4,082	
Compensation		$9,125	$18,251	$22,440	$22,440	
Low Quality	Recruit/DEP	Year 1	Year 2	Year 3	Year 4	
Costs						
Recruiting	$7,018					
Training		$19,614			$4,082	
Compensation		$9,125	$18,251	$22,440	$22,440	
		Cost Table For Varying % HQ				
% HQ	HQ Cost ($M)	LQ Cost ($M)	Total Cost ($M)			
	$2,604	$2,450	$5,054			
0.00	$0	$4,901	$4,901			
0.10	$521	$4,411	$4,931			
0.20	$1,041	$3,921	$4,962			
0.30	$1,562	$3,431	$4,993			
0.40	$2,083	$2,940	$5,023			
0.50	$2,604	$2,450	$5,054			
0.60	$3,124	$1,960	$5,085			
0.70	$3,645	$1,470	$5,115			
0.80	$4,166	$980	$5,146			
0.90	$4,686	$490	$5,176			
1.00	$5,207	$0	$5,207			

Spreadsheet No. 2
LCC Calculations
(Adjusted for Performance)

		1	2	3	4	5	
			LCC High Quality Force				
	Required Contracts	Access/DEP	Year 1	Year 2	Year 3	Year 4	
Attrition %		0.1320	0.1229	0.1804	0.2196	0.1449	
Number of Soldiers	42,030	36,482	31,998	26,226	20,467	17,501	
Average Inventory (Mid Year)			34,240	29,112	23,346	18,984	
Performance Factor			0.886	0.940	0.968	1.000	
Performance Adjusted Man-Years			30,337	27,365	22,599	18,984	
Cost (FY 93 $)							
Recruiting		$387,547,392					
Training			$627,614,428	$0	$0	$71,439,082	
Compensation			$291,984,381	$478,647,024	$459,270,775	$392,722,440	
Total (FY 93 $)		$387,547,392	$919,598,809	$478,647,024	$459,270,775	$464,161,522	
Inflator/Deflator (FY 95 $)		1.0330	1.0191	1.0000	0.9794	0.9559	
Constant FY 95 $		$400,336,456	$937,163,147	$478,647,024	$449,809,797	$443,691,999	
Discount Factor	2.20%	1.0000	0.978473581	0.957410549	0.936800929	0.916634960	
Discounted Cost		$400,336,456	$916,989,380	$458,261,710	$421,382,236	$406,703,597	
LCC	Variable	$2,603,673,379					
	Reference (17,500)	$2,603,524,606	$148,773	◄ MLCC			
			LCC Low Quality Force				
	Required Contracts	Access/DEP	Year 1	Year 2	Year 3	Year 4	
Attrition %		0.1140	0.1332	0.1083	0.1817	0.2064	
Number of Soldiers	39,353	34,867	30,223	26,949	22,053	17,501.074114	
Average Inventory (Mid Year)			32,545	28,586	24,501	19,777	
Performance Factor			0.778	0.875	0.905	0.931	1.074114
Performance Adjusted Man-Years			25,320	25,013	22,174	18,412	
Cost (FY 93 $)							
Recruiting		$244,695,616					
Training			$592,785,945	$0	$0	$71,439,385	
Compensation			$275,781,164	$491,855,077	$494,864,041	$392,724,103	
Total		$244,695,616	$868,567,109	$491,855,077	$494,864,041	$464,163,488	
Inflator/Deflator (FY 95 $)		1.0330	1.0191	1.0000	0.9794	0.9559	
Constant FY 95 $		$252,770,571	$885,156,741	$491,855,077	$484,669,842	$443,693,878	
Discount Factor		1.0000	0.978473581	0.957410549	0.936800929	0.916634960	
Discounted Cost		$252,770,571	$866,102,486	$470,907,240	$454,039,158	$406,705,320	
LCC	Variable	$2,450,524,775					
	Reference (17,500)	$2,450,374,376	$150,399	◄ MLCC			
			Representitive Force LCC (Four Year Life Cycle)				
	%	End Strength	LCC ($M)	ManYears	LCC/End Strength	LCC/Man-Years	MLCC
HQ	50%	17,501	$2,603,673,379	99,285	$148,773	$26,224	$148,773
LQ	50%	17,501	$2,450,524,775	90,918	$140,022	$26,953	$150,399
Total	100%	35,002	$5,054,198,154	190,203			
					MLCC Savings For HQ	► -1.08%	
		AMCOS Figures for LCC					
High Quality	Recruit/DEP	Year 1	Year 2	Year 3	Year 4		
Costs							
Recruiting	$10,623						
Training		$19,614			$4,082		
Compensation		$9,125	$18,251	$22,440	$22,440		
Low Quality	Recruit/DEP	Year 1	Year 2	Year 3	Year 4		
Costs							
Recruiting	$7,018						
Training		$19,614			$4,082		
Compensation		$9,125	$18,251	$22,440	$22,440		

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